163285

FINAL CONSTRUCTION REPORT

FOR REMEDIAL CONSTRUCTION WORK
FORMER JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Prepared for:

Schuller International, Inc.
Littleton, Colorado
(Formerly Known as Manville Sales Corporation
Denver, Colorado)

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CONESTOGA-ROVERS & ASSOCIATES

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1.0 INTRODUCTION

The former Johns-Manville Disposal Area (Site) is located on the eastern portion of the Schuller International, Inc. (Schuller) production facility (Plant) in Waukegan, Illinois. A Site location map is presented on Plan 1 of the "Record Drawing Set for Remedial Construction Work, Former Johns-Manville Disposal Area, Waukegan, Illinois" (Record Drawing Set), dated November 1992 and prepared by Conestoga-Rovers & Associates (CRA). The Record Drawing Set consists of Plans 1 through 14. Since commencement of manufacturing activities in 1922, scrap and miscellaneous wastes from the Plant have been disposed of at the Site. Prior to about 1983, a portion of the scrap and miscellaneous wastes contained encapsulated and friable asbestos.

In 1982 the Site was included on the National Priorities List (NPL). On June 14, 1984, the United States Environmental Protection Agency (USEPA) and Schuller entered into a Consent Order under which Schuller agreed to conduct a Remedial Investigation (RI) and Feasibility Study (FS) for the Site. The RI Report was completed and submitted to USEPA and Illinois Environmental Protection Agency (IEPA) in July 1985[1]. The FS Report was completed and submitted to the USEPA and IEPA in December 1986. A revised FS Report, containing a proposed plan for remedial action at the Site, was submitted to USEPA and IEPA by Schuller in January 1987. An Addendum to the FS Report was written by USEPA on January 28, 1987.

[1] Although the IEPA was not a party to the RI/FS Consent Order, IEPA participated in the process and provided technical comments on the RI/FS reports, and other deliverables throughout the course of the remediation project.

On December 31, 1987, the USEPA, the State of Illinois and Schuller entered into a Remedial Design/Remedial Action (RD/RA) Consent Decree (Case Number 88C630) under which Schuller agreed to fund, develop and implement a remedial action plan for the Site. Under this agreement USEPA Region V assumed "Lead Agency" responsibility.

In March 1988, Schuller submitted to the USEPA for review and approval the "Work Plan for Remedial Action" at the Johns-Manville Disposal area, dated March 1988 and prepared by C. C. Johnson and Malhotra, P. C. (CCJM). After one revision and a dispute resolution proceeding, the USEPA granted approval on October 17, 1988 to proceed with the revised"(Amended) Work Plan for Remedial Action" at the Johns-Manville Disposal Area (Amended Work Plan) dated June 1988 (revised September 1988) and prepared by CCJM. Included in the Amended Work Plan were the:

- Site Health and Safety Plan;
- Quality Assurance Project Plans;
- Sludge Dredging Plan;
- Remedial Contingency Plans;
- Plant Material Information;
- Specifications; and
- Plan Drawings.

Field implementation of the Amended Work Plan commenced following USEPA approval with several work activities performed by Schuller prior to selection of a Remedial Contractor. On or about October 21, 1988, field implementation of the Amended Work Plan by Schuller's Remedial Contractor commenced. Early in the performance of the work, disputes arose between USEPA and Schuller concerning each party's interpretation of the Amended Work Plan, Project Specifications and Plans. On January 10, 1989, USEPA ordered the cessation of Site activities. On February 17, 1989, USEPA approved the recommencement of remedial construction activities at the Site on a limited basis.

On April 28, 1989, Schuller submitted to USEPA the "Work Plan Supplement - Schuller Former Waste Disposal Area, Waukegan, Illinois" (Work Plan Supplement) dated April 28, 1989 and prepared by CRA for review and approval. The Work Plan Supplement was developed to minimize the potential for disagreements with regard to the proper execution of the work and to allow Site remedial construction activities to continue. USEPA granted approval for the Work Plan Supplement on May 5, 1989 and full construction activities recommenced. All remedial construction activities specified in the Amended Work Plan and Work Plan Supplement were completed by May 31, 1990, as specified in the Consent Decree.

During the course of performing remedial construction activities, potential asbestos-containing waste materials/soils (ACM) were observed in certain areas not addressed under the scope of the Amended Work Plan or Work Plan Supplement including the South Central area - west, Semi-trailer Staging area, East Border Area and banks of the Pumping Lagoon, Industrial Canal and Borrow Pit areas, further identified on Plan 2 of the Record Drawing Set. On February 7, 1990, representatives of USEPA, IEPA and CRA collected samples of the miscellaneous waste materials/soils for asbestos analysis. Analysis of the samples collected confirmed the presence of asbestos. Subsequently, on July 31, 1990, Schuller submitted to the USEPA for review and approval the "Second Work Plan Supplement - Waukegan Remedial Site", (Second Work Plan Supplement) dated July 1990 and prepared by CRA. USEPA approval for the Second Work Plan Supplement was granted on August 3, 1990. Schuller's remedial contractor commenced field implementation of the Second Work Plan Supplement activities on August 13, 1990. All work specified under the Second Work Plan Supplement was completed by December 31, 1990.

During field implementation of the Second Work Plan Supplement, ACM primarily comprised of broken Transite® was identified on the Borrow Pit perimeter road located north of the Plant buildings and adjacent areas. On November 13, 1990, Schuller submitted to the USEPA the "Second Work Plan Supplement - Amendment A" (Amendment A), dated November 13, 1990 and prepared by CRA, to address the area around the Borrow Pit . The USEPA approval for Amendment A was granted on November 27, 1990. Schuller's Remedial Contractor commenced Amendment A remedial construction activities on January 21, 1990 and completed work by May 31, 1991.

In June 1991, Schuller submitted to USEPA the "Third Work Plan Supplement", dated June 1991 and prepared by CRA addressing the remediation of two final areas confirmed to contain ACM (Area Y and Area Z) not covered by the Amended Work Plan, Work Plan Supplement, Second Work Plan Supplement or Amendment A to the Second Work Plan Supplement. USEPA approval for the Third Work Plan Supplement was granted on July 2, 1991. Schuller's Remedial Contractor commenced Third Work Plan Supplement remedial construction activities on July 15, 1991 and completed all specified work by August 21, 1991.

This report presents a summary of remedial work performed at the former Johns-Manville Disposal Area and adjacent areas from October 1988 to August 21, 1991.

2.0 SITE PERSONNEL

2.1 USEPA/IEPA

A remedial project manager (RPM) was designated by the USEPA from the USEPA Region V offices to act as the USEPA on-Site Coordinator (OSC). The OSC's responsibility was to observe and monitor the progress of all remedial construction activities to ensure that work was performed in accordance with the Consent Decree. The USEPA OSC was on-Site daily when work was performed by Schuller's Remedial Contractor from November 28, 1988 to January 10, 1989. The USEPA OSC visited the Site on a weekly to monthly basis from January 10, 1989 to August 21, 1991.

An IEPA project coordinator was designated by IEPA to participate in the monitoring of field activities and review of project plans. The IEPA project coordinator visited the Site on several occasions to observe the remedial construction work.

USEPA retained W. W. Science and Engineering of Grand Rapids, Michigan to act on its behalf at the Site on a day to day basis for the majority of the project. W. W. Science and Engineering representatives were on Site daily when work was performed from January 9, 1989 to May 31, 1990 and from August 13, 1990 to February 26, 1991.

2.2 SCHULLER/CRA

From the period of October 18, 1988 to May 3, 1989, Schuller assigned corporate personnel to be present at the Site during remedial construction activities on a full-time basis. Schuller's on-Site Representative (OSR) was responsible for the day-to-day implementation of the remedial action and for directing the remedial contractor.

On May 4, 1989, Schuller retained CRA to manage the remedial action implementation at the Site and to perform the duties of the OSR. CRA representatives were on Site during work activities from May 4, 1989 to August 21, 1991.

O'Brien and Associates, Inc. (O'Brien) of Arlington Heights, Illinois was retained by CRA to perform all necessary materials testing, including in-place soil cover compaction testing, concrete testing and laboratory soils testing. O'Brien field representatives were on Site periodically from May 1989 to August, 1991.

CCJM of Grand Rapids, Michigan was retained by Schuller to implement the Ambient Air Monitoring program specified in the Amended Work Plan and to collect samples of miscellaneous materials. CCJM representatives were on Site daily from October 22, 1988 to May 7, 1990 and from August 13, 1990 to October 12, 1990 for ambient perimeter air monitoring and miscellaneous sample collection. In addition to the Air Monitoring program and sampling of miscellaneous materials, CCJM was retained by Schuller to conduct the RD/RA groundwater/surface water monitoring program at the property.

Ayers, Lewis, Morris and May (ALM&M) of Ann Arbor, Michigan was retained by Schuller from December 5, 1988 to May 8, 1989 to perform day-to-day Site surveying functions as required for the field implementation of the Amended Work Plan. Lake County Land Surveying (LCLS) of Zion, Illinois subsequently was retained by CRA, on behalf of Schuller, to perform surveying required during Site remedial construction activities. LCLS was on-Site periodically from May 1989 to May 1991.

Fox Drilling Company (Fox) of Itasca, Illinois was retained by CRA, on behalf of Schuller, to abandon several on-Site groundwater monitoring wells during Work Plan Supplement remedial construction activities and to extend the casings of other on-Site groundwater monitoring wells in conjunction with the Second Work Plan Supplement remedial construction activities. Fox was on-Site on September 20, 1989 and from September 13, 1990 to September 14, 1990.

Gloss Guard and Investigation Services (Gloss) of Lombard, Illinois was contracted by Schuller to provide daily Site security services from November 28, 1988 to May 31, 1990 and from August 15, 1990 to February 26, 1991. Gloss provided a Site security guard at the entrance to the Site typically for at least eight hours per day while remedial construction activities were implemented on-Site.

2.3 REMEDIAL CONTRACTORS

2.3.1 Lake County Grading Company

Lake County Grading Company (LCGC) of Libertyville, Illinois was contracted by Schuller to perform all major Site remedial construction activities at the direction of Schuller's OSR. LCGC was present at the Site from November 1988 to August 1991.

Throughout the course of performing remedial construction activities, several specialty contractors were subcontracted by LCGC to perform various remedial construction tasks. A listing of LCGC's subcontractors and associated tasks performed is presented in Table 2.1.

2.3.2 Diversified Abatement Contractors, Inc.

Diversified Abatement Contractors, Inc. (DAC) of Waukegan, Illinois was contracted by Schuller to perform surficial cleanup of ACM under the Third Work Plan Supplement. DAC performed the surficial ACM cleanup activities from June 17, 1991 to July 12, 1991. RCM Laboratories, Inc. (RCM) of Brookfield Illinois was subcontracted by DAC to perform all personnel air monitoring during the surficial ACM cleanup.

TABLE 2.1

LAKE COUNTY GRADING COMPANY SUBCONTRACTOR SUMMARY

Name	*City*	*State*	*On Site* *From*	*To*	*Work Performed*
Benson Electric, Inc.	Waukegan	Illinois	October 21, 1988 June 14, 1989	November 28, 1988 June 23, 1989	Mobilization, Black Ditch power pole and power line relocation, Industrial Canal Pump relocation.
Christian's Tree Service	Libertyville	Illinois	May 4, 1989	May 15, 1989	Clearing, grubbing trees and shrubs.
Diemer Plumbing	Antioch	Illinois	October 28, 1988	November 18, 1988	Support facilities hookups.
Falcon Marine Company	Waukegan	Illinois	September 12, 1989	September 29, 1989	Black Ditch sheet pile retainment structure.
Falduto Construction Company	Waukegan	Illinois	September 24, 1990	September 26, 1990	Semi-trailer dolly pads.
H. H. Holmes Testing Laboratories, Inc.	Wheeling	Illinois			Soils testing.
Hunter Land and Lawn	Millburn	Illinois	August 4, 1989	August 7, 1989	Asbestos Disposal Pit seeding.
J. V. Construction Co., Inc.	Fox Lake	Illinois	October 28, 1988	November 23, 1988	Support facilities hookups.
Liquid Waste Technology, Inc.	Somerset	Wisconsin	April 4, 1989	July 13, 1989	Wastewater treatment system sludge dredging.
Martens Fencing	Lake Villa	Illinois	October 5, 1988	May 24, 1989	Site fencing.
Midwest Tar Sealing Company	Itasca	Illinois	December 11, 1990	December 13, 1990	West parking lot sealing.
Scheduled Construction Corp.	Libertyville	Illinois	October 26, 1988	July 8, 1989	Equipment decontamination pad, Settling Basin spillway, Black Ditch wet well.
Skokie Valley Asphalt Company, Inc.	Grayslake	Illinois	December 10, 1990	December 20, 1990	West parking lot patching.

2.3.3 Peter Baker and Son Company

Peter Baker and Son Company (Baker) of Lake Bluff, Illinois was contracted by Schuller to construct a bituminous pavement cover on portions of Area Y and Area Z pursuant to the Third Work Plan Supplement. Baker constructed the bituminous pavement covers at the Site on August 20, 1991 and August 21, 1991.

3.0 PROJECT MANAGEMENT

3.1 ORGANIZATION

3.1.1 USEPA

The USEPA RPM and/or OSC and IEPA project coordinator were responsible for observing and monitoring the progress of the remedial construction activities to ensure that work was in accordance with the remedial design described in Article V of the Consent Decree and all subsequent Work Plans.

3.1.2 Schuller

Schuller/CRA project manager (PM) and OSR were responsible for the management of the remedial action implementation, resolution of concerns raised by the USEPA OSC or his representatives, and direction of Schuller's remedial contractors in the effective and efficient performance of the remedial construction work.

3.1.3 Lake County Grading Company

LCGC was Schuller's primary remedial contractor and was responsible to Schuller for performance and completion of major Site remedial construction activities in accordance with the Consent Decree and all subsequent Work Plans. Responsibilities included reporting to and receiving direction from the OSR or PM and directing subcontractor activities.

3.2 SITE MEETINGS

The USEPA OSC's representative, Schuller's OSR and LCGC met on a weekly basis to discuss, review and resolve schedule and work-related issues during the period of November 28, 1988 to January 18, 1990. From February 21, 1990 to February 13, 1991, Site meetings were held on a monthly frequency. Minutes of these meetings were generated and distributed to all parties to maintain communication from the field to upper management. In addition to the official weekly Site meeting, the OSC representative, OSR and the remedial contractor's representative met daily, as necessary, to discuss and resolve daily work-related issues. Any problems which could not be resolved during these meetings were deferred to the OSC and PM for resolution at the Site meeting.

Contractor daily tool box meetings with on-Site personnel were held by LCGC where safety and general work related issues were discussed and LCGC personnel directed.

A weekly health and safety meeting for on-Site contractor and subcontractor personnel was conducted from November 11, 1988 to November 28, 1990 by LCGC's on-Site Health and Safety Officer as part of the Health and Safety Plan administration. The health and safety meeting was held to allow all on-Site personnel to communicate specific problems or concerns with the health and safety officer. General work area related safety concerns were also addressed.

4.0 REMEDIAL SOIL COVER

4.1 GENERAL

As outlined in the FS report and Addendum, USEPA Record of Decision (ROD) and Consent Decree, and as specified in "Attachment B, Specifications for Remedial Construction Work " and the Plan Drawings, both dated June 1988 and prepared by CCJM (Attachment B of the Amended Work Plan), the typical remedial soil cover designed for the Site with the exception of sloped areas and heavily traveled areas, consisted of a 24-inch thick compacted, non-asbestos containing, composite soil cover with vegetation (remedial soil cover). The typical remedial soil cover was comprised of:

- a minimum six-inch thick sand layer;
- a 15-inch thick compacted clayey soil layer; and
- a three-inch thick topsoil layer with vegetation.

On sloped surfaces (slopes greater than 20 percent), the slopes were typically backfilled with several feet of sand from the Borrow Pit, except as noted in this report, and graded to a new slope grade of approximately two horizontal to one vertical (2:1) prior to placement of the 15-inch thick clayey soil layer and three-inch thick topsoil layer with vegetation. A minimum six-inch thick sand cover layer was maintained over the waste materials.

On sloped surfaces (slopes greater than 20 percent) adjacent to water bodies, the standard remedial cover as described above was typically constructed. Also, a six-foot wide, 12-inch thick riprap layer underlined with geotextile was constructed on these slopes at the water-slope interface to protect the slope from wave action erosion.

Remediation areas subject to Plant vehicular traffic during and after Site remedial construction received the following remedial soil cover:

- a minimum 12-inch thick sand layer overlain by a 12-inch thick compacted crushed gravel layer on heavily traveled areas (Class I); or

- a minimum 14-inch thick sand layer overlain by a 10-inch thick compacted crushed gravel layer on lightly traveled areas (Class II).

Under the Third Work Plan Supplement, Area Y and portions of Area Z were remediated by construction of a remedial cover consisting of:

- a minimum six-inch thick compacted gravel layer; and
- a minimum two-inch thick bituminous pavement cover.

Section 4.4 of this report further details the remedial construction activities performed on specific areas of the Site.

4.2 CLEARING AND GRUBBING

In November 1988 LCGC commenced clearing and grubbing of existing trees and shrubs from the Site to facilitate unobstructed construction of the remedial soil cover. Two methods of clearing were implemented by LCGC.

The first method involved the traditional felling of trees using chain saws and clearing by loading and transporting the fallen trees to selected USEPA approved disposal areas on-Site. During the period of November 1988 to June 1989, removed trees and shrubs were disposed of in the former Asbestos Disposal Pit and subsequently backfilled with non-asbestos containing sand. Following closure of the Asbestos Disposal Pit in June 1989, removed trees and shrubs were disposed of in the Active Miscellaneous Waste Disposal Pit (AMWDP).

The second method of clearing implemented by LCGC involved felling trees by pushing them over with a backhoe. The fallen trees then were either left in place and covered with the remedial soil cover or transported to a USEPA approved disposal area on Site. This method was implemented primarily in areas adjacent to water bodies, areas with low topography and in the Borrow Pit.

In the Borrow Pit, where fill sands were dredged and utilized for the remedial soil cover, fallen trees and shrubs generated by clearing were staged in several stockpiles and left to deteriorate naturally.

Clearing and grubbing of the Site was performed concurrently with all phases of remedial construction activities as required. All clearing and grubbing activities were completed by late January 1991.

4.3 ROUGH GRADING

Except as described in Sections 4.4.1 through 4.4.3, 4.4.19, 4.5 and 4.6.2, grading of the existing materials/soils on Site was not permitted without approval from the USEPA OSC. Where grading of the existing material/soils was necessary for construction of the soil cover, generally, the area to be graded was first thoroughly saturated with water using the remedial contractor's sprinkler system or water truck. In addition, daily personnel and perimeter air monitoring samples were collected by LCGC and CCJM as specified in the Amended Work Plan and further discussed in Sections 8.4 and 9.0.

Final grading of the majority of the remedial soil cover subgrade was achieved by backfilling with sand from the Borrow Pit. Sand backfill was graded to promote positive surface stormwater run off.

4.4 SOIL COVER PLACEMENT

Several types of remedial soil cover were constructed, including:

- a 24-inch thick composite soil cover consisting of a six-inch sand layer, 15-inch clay layer and a three-inch topsoil layer and vegetation;
- a 24-inch thick composite gravel cover consisting of either 12 or ten inches of compacted gravel underlain by 12 or 14 inches of sand base, respectively;
- a 12-inch thick composite gravel cover; and
- a 12-inch thick riprap cover underlain by geotextile and a 12-inch thick sand bedding.

Sand used for fill and soil cover was obtained from an on-Site Borrow Pit located northwest of the former waste disposal areas. Sand dredged from the Borrow Pit by LCGC was transported to the work area by 25-cubic yard capacity quarry trucks or 15-cubic yard capacity dump trucks. Sand typically was spread using a dozer on flat surfaces and a backhoe on sloped areas. Prior to utilizing sand from the Borrow Pit, LCGC retained H. H. Holmes Testing Laboratories, Inc. of Wheeling, Illinois (H. H. Holmes) to collect and analyze samples of the Borrow Pit sand for asbestos content, optimum density, optimum moisture content, field moisture content and grain size distribution as specified in Attachment B of the Amended Work Plan. In addition, CRA retained O'Brien to collect and analyze the sand for asbestos content as a quality assurance check on the H. H. Holmes test data. The analytical sand testing results are summarized in Table 4.1. Actual analytical data for the sand samples as presented by H. H. Holmes and O'Brien are reproduced in Appendix A and B, respectively.

Clay soil was imported from several LCGC off-Site borrow sites by semi-trailer dump trucks and placed over the sand covered remediation areas. Prior to transporting the clay to the Site, LCGC submitted samples of clay from proposed clay borrow sites to H. H. Holmes for soils testing as specified in Attachment B of the Amended Work Plan. Samples were analyzed for asbestos content, organic content, optimum density, optimum moisture content, field moisture content, pH and grain size. In addition, samples from most of LCGC's proposed clay borrow sites were collected by the OSR and submitted to O'Brien for duplicate soil analysis as a quality control check. A summary of all clay soil test data reported by H. H. Holmes and O'Brien is presented in Table 4.2. Testing reports by H. H. Holmes and O'Brien are reproduced in Appendices A and B, respectively. Clay soils were spread over the sand cover to a minimum depth of 15 inches on inactive areas and 26 inches on active or proposed future miscellaneous solid waste disposal areas with a dozer or road grader on flat surfaces or with a backhoe on sloped surfaces. Clay was compacted by tracking with heavy equipment to a minimum of 90% of Standard Proctor density in accordance with Attachment B of the Amended Work Plan. O'Brien field inspectors verified field densities of the in-place clay cover throughout its construction. Field density measurements for the clay cover as tested and reported by O'Brien, are reproduced in Appendix C.

TABLE 4.1

SUMMARY OF BORROW PIT SAND SAMPLES
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS-MANVILLE DISPOSAL AREA
MANVILLE, WAUKEGAN

Sample	*Material*	*Asbestos Fiber Concentration*	*Proctor (PCF)*	*Optimum Moisture*	*Field Moisture*	*pH*	*% Organic*	*% Sand*	*%Silt*	*%Clay*	*Reporting Laboratory*
1	Fine Sand with some Gravel	ND	104.9	9.5%	8.2%	6.8	None	94	6	0	H. H. Holmes
2	Fine Sand with some Gravel	ND	106.8	9.4%	7.8%	6.8	None	96	4	0	H. H. Holmes
3	Fine Sand with some Gravel	ND	105.8	9.5%	7.9%	6.8	None	95	5	0	H. H. Holmes
--	Fine Sand with Gravel	ND	105.5	9.5%	4.6%	6.8	None	94	6	0	H. H. Holmes
--	Fine Sand with Gravel	ND	105.7	9.3%	0.8%	6.8	None	96	4	0	H. H. Holmes
--	Tan Sand from Stockpile	<1%	--	--	--	--	--	--	--	--	O'Brien

TABLE 4.2

SUMMARY OF CLAY SOIL TEST DATA
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS -MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Source	*Soil Type*	*Asbestos Fiber Concentration*	*pH*	*% Organic*	*% Moisture*	*Standard Protcor (LBS/C.F.)*	*Optium Moisture*	*% Sand*	*% Silt*	*% Clay*	*% Gravel*	*Plast. Index*	*Class*	*Reported By*	*Comments*
Grand Tri-State	Brown, Silty Clay	ND	6.7	3.1	19.5	115.4	13.5	15	40	45	0	17	CL	Holmes	
Pembrook	Brown, Silty Clay	ND	6.6	3.6	14.6	123.0	10.5	15	48	37	0	15	CL	Holmes	
Rte 137/Buckley Road	Gray Clayey Silt	ND	6.7	2.1	13.0	128.4	10.5	19	52	29	0	10	CL	Holmes	
Rte 137/Buckley Road	Brown Silty Clay	ND	6.5	2.4	9.5	122.1	12	24	49	27	0	12	CL	Holmes	
Area D3 (N. Dry Waste Pile) (Buckley Road)	Brown-Gray Silty Clay to Clayey Silt	<1 %	NT	NT	NT	114.5	15.5	NT	NT	NT	NT	NT	NT	Obrien	Note 1
Area F12-F13 (East Ditch) (Pembrook)	Brown Silty Clay	<1 %	NT	NT	NT	106.2	17.8	NT	NT	NT	NT	NT	NT	Obrien	Note 1
Area C1 (West Slopes/North) (Pembrook)	Brown Silty Clay	<1 %	NT	NT	NT	120.5	10.8	NT	NT	NT	NT	NT	NT	Obrien	Note 1
Area C2 (Stage 1 Trough-North) (Buckley Road)	Brown Silty Clay	<1 %	NT	NT	NT	113	13.5	NT	NT	NT	NT	NT	NT	Obrien	Note 1
Area D13 (East Ditch) (Pembrook)	Dk. Brown Silty Clay	<1 %	NT	NT	NT	107.5	16	NT	NT	NT	NT	NT	NT	Obrien	Note 1
Asbestos Disp. Pit Area (Buckley Road)	Brown Silty Clay	<1 %	NT	NT	NT	115	13.6	NT	NT	NT	NT	NT	NT	Obrien	Note 1

Notes:

1. No observed asbestos events for particles >5 microns.
2. <1% denotes non-asbestos containing material

ND - None Detected
NT - Not Tested
NR - Not Reported

TABLE 4.2

SUMMARY OF CLAY SOIL TEST DATA
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS -MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Source	*Soil Type*	*Asbestos Fiber Concentration*	*pH*	*% Organic*	*% Moisture*	*Standard Protcor (LBS/C.F.)*	*Optium Moisture*	*% Sand*	*% Silt*	*% Clay*	*% Gravel*	*Plast. Index*	*Class*	*Reported By*	*Comments*
Yorkhouse Rd.	Brown Silty Clay w/trace gravel	ND	6.7	2.1	14.5	NT	NT	7	45	48	0	21	CL	Holmes	Insufficient sample for Proctor test
Fort Sheridan	Brown Silty Clay w/trace gravel	ND	6.6	3	10	121	12.4	11	53	36	0	15	CL	Holmes	
Fort Sheridan	Brown Silty Clay w/trace gravel	ND	6.7	1.6	17.1	114.8	11.5	12	53	35	0	8	CL	Holmes	
Fort Sheridan	Gray Silty Clay w/trace gravel	<1%	8	3	10.3	113.5	15	14	36	50	0	11	CL	Obrien	Note 1
Skokie Lagoon	Brown Silty Clay w/trace gravel	ND	6.8	3.2	22.7	109.5	15.2	14	43	43	0	16	CL	Holmes	
Skokie Lagoon	Brown Silty Clay w/some sand	NT	NT	NT	NT	113.5	13.5	NT	NT	NT	NT	NT	NT	Obrien	Note 1
Grandview	Brown Silty Clay	<1%	6.7	3.8	14.3	115.8	14.8	17	44	39	0	11	CL	Holmes	Note 2
Grandview	Brown & Gray Silty Clay w/tr topsoil	<1%	NT	NT	NT	107.5	17	15	35	50	0	16	CL	Obrien	Note 1
Hawthorne Court	Brown Sandy Silty Clay	<1%	6.8	5.1	8.6	119.2	12.7	28	43	25	0	10	CL	Holmes	Note 2
Hawthorne Court	Brown Silty Clay	<1%	NT	NT	NT	109.5	16.2	34	0	66	0	14	CL	Obrien	Note 1

Notes:

1. No observed asbestos events for particles >5 microns.
2. <1% denotes non-asbestos containing material

ND - None Detected
NT - Not Tested
NR - Not Reported

TABLE 4.2

SUMMARY OF CLAY SOIL TEST DATA
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS -MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Source	Soil Type	Asbestos Fiber Concentration	pH	% Organic	% Moisture	Standard Protcor (LBS/C.F.)	Optium Moisture	% Sand	% Silt	% Clay	% Gravel	Plast. Index	Class	Reported By	Comments
Hawthorne Court	Brown Silty Clay	<1%	NT	NT	NT	109.5	16.2	34	0	66	0	14	CL	Obrien	Note 1
Abbott	Brown Silty Clay	<1%	6.6	1.5	12.7	110.3	16.7	6	39	55	0	13	CL	Holmes	Note 2, Note 3
Hyundai/Washington	Brown Silty Clay	<1%	6.8	5.5	9.7	111.7	12.8	12	54	34	0	13.1	CL	Holmes	Note 2
Tri-state Pond	Brown Silty Clay	<1%	6.8	6	11.8	115.7	13.4	16	51	33	0	14.6	CL	Holmes	Note 2
Lake Michigan Water Supply	Brown Silty Clay	<1 %	6.9	3.6	12.5	115.4	14.3	8	44	48	0	12	CL	Holmes	Note 2
Lake Michigan Water Supply	Brown Silt	<1 %	NT	NT	NT	116	15.5	26	39	28	7	4	CL-ML	Obrien	Note 1
Victory Hospital	Brown Silty Clay	<1%	6.8	4.9	12	116	13.3	16	41	43	0	10.7	CL	Holmes	Note 2
Waukegan West High School	Brown Silty Clay	<1%	6.8	2	15.1	113.2	3.7	2	45	53	0	13	CL	Holmes	Note 2
Waukegan West High School	Gray Silty Clay w trace sand & gravel	<1%	8.2	4.05	15.4	116.5	16.3	21	36	28	15	7	CL	Obrien	Note 1
South Stockpile	Brown Silty w/some clay & sand w/tr gravel	<1 %	NT	NT	NT	116.5	15	31	45	23	1	NT	CL-ML	Obrien	Note 1
Bethesda Village	Brown Silty Clay	<1%	7.2	3	NR	112.7	16	32	0	63	5	11	CL	Obrien	Note 1

Notes:

1. No observed asbestos events for particles >5 microns.
2. <1% denotes non-asbestos containing material
   ND - None Detected
   NT - Not Tested
   NR - Not Reported
3. This clay was tested but these materials were not used at the Manville Site.

Topsoil for the remedial soil cover was imported from several LCGC off-Site borrow sites. These soils were sampled by LCGC and the OSR and tested in accordance with Attachment B of the Amended Work Plan by H. H. Holmes and O'Brien, respectively. The analytical data for topsoil samples are summarized in Table 4.3. Analytical data reports from H. H. Holmes and O'Brien are reproduced in Appendices A and B, respectively.

Topsoil imported to the Site was spread to a minimum depth of three inches utilizing a backhoe or dozer on sloped areas and a dozer or road grader on flat surfaces. Sticks, roots, and large stones were removed from the topsoil following placement and were disposed of in the AMWDP. Topsoil cover was fertilized in accordance with Attachment B of the Amended Work Plan and then was seeded with one of two seed mixtures as listed in Table 4.4. Seed mixtures differed between sloped areas near water bodies and flat areas to minimize future maintenance needs in these areas as approved by USEPA.

As discussed in Section 6.11 the West Perimeter Drainage Ditch, was sodded in lieu of seeding.

In areas requiring ongoing access by Plant maintenance vehicles, the clay and vegetated topsoil components of the remedial soil cover were replaced by compacted crushed gravel cover. Following placement of at least 12 inches (Class I gravel cover) or 14 inches (Class II gravel cover) of sand from the Borrow Pit, LCGC placed crushed limestone supplied by Vulcan Materials Company of Countryside, Illinois over the sand cover. With the

TABLE 4.3

SUMMARY OF TOPSOIL TEST DATA
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS -MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Source	*Soil Type*	*Asbestos Fiber Concentration*	*pH*	*% Organic*	*% Moisure*	*% Sand*	*% Silt*	*% Clay*	*% Pass #10 Sieve*	*Plast. Index*	*Class*	*Reported By*	*Comments*
Deer Valley/ Woodfield Estates	Black Topsoil	ND	6.4	8.5	28	5	50	45	95	NR	NR	HOLMES	
Washington/Hyundai	Topsoil	ND	6.6	5.7	22.6	19	56	25	90	14	CL	HOLMES	
Washigton/RTE 21	Black Topsoil	ND	6.7	7.1	25.3	17	58	25	93	14	CL	HOLMES	
Grand Tri-State	Black Topsoil	ND	6.7	6.4	19.3	24	42	34	95	13	CL	HOLMES	
Grand Tri-State	Black Topsoil	<1%	NT	NT	NT	NT	NT	NT	NT	NT	NR	OBRIEN	Note 1
Grandview	Black Topsoil	<1%	16.5	4.5	21.5	24	51	25	94	11	CL	HOLMES	Note 2
Grandview	Black Topsoil	<1%	NT	NT	NT	NT	NT	NT	NT	NT	NR	OBRIEN	Note 1
Skokie Lagoon	Black Topsoil	<1%	6.7	9	22.5	26	48	26	95	15.1	ML	HOLMES	Note 2
Skokie Lagoon	Black Organic Clay	<1%	NT	NT	NT	32	35	33	NR	23	CH-OH	OBRIEN	Note 1
Sunset & Delaney	Black Topsoil	<1%	6.7	7.9	17.6	21	41	38	97	16.5	CL	HOLMES	Note 2

Notes:

1. No observed asbestos events for particles >5 microns.
2. <1% denotes non-asbestos containing material

ND - None Detected
NT - Not Tested
NR - Not Reported

TABLE 4.3

SUMMARY OF TOPSOIL TEST DATA
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS -MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Source	*Soil Type*	*Asbestos Fiber Concentration*	*pH*	*% Organic*	*% Moisure*	*% Sand*	*% Silt*	*% Clay*	*% Pass #10 Sieve*	*Plast. Index*	*Class*	*Reported By*	*Comments*
Sunset & Delaney	Black Silty Clay w/ Some Sand	<1%	NT	NT	NT	20	44	36	NR	23	CL-ML	OBRIEN	Note 1
Abbott	Black Topsoil	<1%	6.8	3.3	24.5	6	44	50	98	14	CL	HOLMES	Note 2
Lake Michigan Water Supply	Black Topsoil	<1%	6.7	7.2	18	26	39	35	95	13.6	CL	HOLMES	Note 2
Lake Michigan Water Supply (from on-Site stockpile)	Black Organic Silt	<1%	6.8	9	NR	28	47	25	NR	NT	OL	OBRIEN	Note 1
Bethesda Village	Black Topsoil	<1%	NT	NT	NT	25	0	75	NR	8.3	OL-ML	OBRIEN	Note 1

Notes:

1. No observed asbestos events for particles >5 microns.
2. <1% denotes non-asbestos containing material

ND - None Detected
NT - Not Tested
NR - Not Reported

TABLE 4.4

SEEDING MIXTURES
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS -MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Area Type	*Seeds*	*lbs/acre*
Flat and sloped areas not adjacent to waterbodies	Kentucky 31 or Alta Fescue	50
	Perennial Rye Grass	30
	Creeping Red Fescaue	20
	Cover Crop	Note [1]
Sloped areas adjacent to water bodies	Crown vetch	15
	Perennial Rye Grass	10
	Alsike Clover	7
	Cover Crop	Note 1

[1]Cover crop consists of either Spring Oats or Winter Rye at an application rate of 48lbs/acre or 56 lbs/acre respectively, depending upon when seeding was placed.

exception of the Semi-Trailer Staging Area, if the area was considered to be heavily traveled (Class I gravel cover), at least an eight-inch depth of three-inch limestone base gravel and a four-inch depth of surface gravel were placed. On lightly traveled (Class II gravel cover) areas at least a six-inch depth of three-inch limestone base gravel and a four-inch depth of surface gravel were placed. In either case, the final thickness of the remedial cover, including sand and gravel, was a minimum of 24 inches compacted to at least 95% of Standard Proctor density as specified in Attachment B of the Amended Work Plan. Typical as-constructed details for the Class I and Class II gravel cover are presented on Plan 13 of the Record Drawing Set.

The Semi-Trailer Staging Area received a 12-inch thick gravel cover consisting of an eight-inch depth of limestone base gravel overlain by a four-inch depth of limestone surface gravel. Sand from the Borrow Pit was used to grade low areas in the Semi-Trailer Staging Area to promote positive surface stormwater drainage. The 12-inch thick gravel cover was compacted to at least 95% of Standard Proctor density. Gravel cover field density tests were conducted by O'Brien field inspectors. All field compaction test data reported by O'Brien is presented in Appendix C.

On sloped areas subject to erosion from surface water runoff or wave action, a 12-inch thick riprap stone cover was constructed in place of clay and topsoil layers as detailed on Plan 13 of the Record Drawing Set. Prior to placement of the riprap stone on these areas, LCGC placed and graded at least 12 inches of sand, to a slope of 2:1, utilizing a backhoe. One layer of Phillips Supac® 4NP geotextile then was placed on the sand cover and held in place by pinning at three-foot centers as specified by the manufacturer.

Riprap stone, supplied by Vulcan Materials Company, was placed on the geotextile with a backhoe to a depth of at least 12 inches as specified in Attachment B of the Amended Work Plan.

The following sections further describe methods used in the construction of the remedial soil cover and associated installations at specific on-Site areas.

4.4.1 North Dry Waste Pile Area

The North Dry Waste Pile Area (NDWPA) identified on Plan 2 of the Record Drawing Set was to be graded and remediated with a 24-inch remedial soil cover. In December 1988, LCGC graded the NDWPA under the direction of Schuller's OSR and the oversight of the USEPA OSC. Using a backhoe and/or bulldozer, LCGC transferred waste materials/soils from areas of high elevation to areas of low elevation until desired grades were achieved. A majority of the waste materials/soils graded were either placed the Old Stage 1 Trough located north of the NDWPA, the Stage 1 Trough located west of the NDWPA or the North Catch Basin located east of the NDWPA. A commercial sprinkling system and water truck were sometimes utilized to wet waste materials/soils with water from the Industrial Canal prior to and during grading operations. Grading of the NDWPA was completed in January 1989.

Following completion of waste material grading activities, final remedial soil cover grades were established in the NDWPA by

ALM & M. Sand cover placement on the NDWPA commenced in February 1989 and was completed in April 1989. Clay cover placement on the NDWPA commenced in May 1989. Topsoil cover placement commenced in August 1989. All remedial soil cover construction on the NDWPA was completed on September 5, 1989.

4.4.2 Old Stage 1 Trough and Stage 1 Trough

The Old Stage 1 Trough and Stage 1 Trough located north and west of the NDWPA, respectively, and further identified on Plan 2 of the Record Drawing Set, were backfilled with waste materials/soil from the NDWPA grading operation as discussed in Section 4.4.1. A minimum six-inch thick sand cover layer was placed over the waste materials. Three out-of-service Schuller Plant dump trucks were purged of all engine oils, had tires deflated and were placed in the base of the the southern most end of the Stage 1 Trough and covered with asbestos containing sludge. Engine oils were disposed of by LCGC with waste engine oils generated through maintenance of LCGC's heavy equipment.

Final sand backfill grades were established and maintained by LCGC in accordance with Attachment B of the Amended Work Plan. Grading of the Old Stage 1 Trough and Stage 1 Trough with sand was completed in April 1989. A clay and topsoil cover was placed concurrently with clay and topsoil placement in the NDWPA and completed on September 5, 1989.

4.4.3 West Sloped Areas

The sloped area along the western perimeter of the disposal area (West Sloped Area), further identified on Plan 2 of the Record Drawing Set, was remediated by construction of a 24-inch thick remedial soil cover. During the construction of the remedial soil cover on the West Sloped Area, the portion of the slope west of the NDWPA was graded using a backhoe. Grading on the balance of the West Sloped Area was achieved by backfilling with sand as discussed in Section 4.3.

In February 1989, following completion of clearing and grubbing operations adjacent to the West Sloped Area, LCGC began grading existing waste material/soils to attain final elevations. ALM & M set grade stakes to establish final grades. Subsequently, waste materials/soils were excavated from along the top of the sloped area west of the NDWPA and Stage 1 Trough and placed into the Stage 1 Trough for backfill using a backhoe. LCGC sometimes utilized an irrigation spray system and a water truck to continuously wet the waste materials/soils prior to and during grading operation. From March, 1989 onwards, the balance of the West Sloped Area was graded by backfilling the slope with sand and grading the sand to a 2:1 slope. In addition, the sloped area previously graded was covered with a minimum of six inches of sand cover as specified in Attachment B of the Amended Work Plan. All West Sloped Area grading and sand cover operations were completed in June 1989.

Clay cover for the West Sloped Area was placed from June 1989 to August 1989. Topsoil and seed placement on the West Sloped Area was completed in September 1989. The West Sloped Area remedial soil cover was completed on September 22, 1989.

4.4.4 North Catch Basins and Drainage Basin

The North Catch Basin and Drainage Basin located east of the NDWPA and further identified on Plan 2 of the Record Drawing Set, were used by the Plant as part of a former process wastewater treatment system. Closure of these waterways by backfilling with subsequent construction of an overlying 24-inch thick remedial soil cover was specified by the Amended Work Plan.

In May, 1989 LCGC backfilled the North Catch Basin and Drainage Basin with sand transported from the Borrow Pit. Prior to sand backfill, portions of the North Catch Basin were partially backfilled with asbestos-containing sludge from the NDWPA grading operations. A minimum 15-inch thick clay cover was placed on the North Catch Basin and Drainage Basin in July 1989. Construction of the topsoil cover over the clay cover was performed by LCGC in August 1989. Remedial soil cover placement on the North Catch Basin and Drainage Basin was completed in September 1989.

4.4.5 West Waste Pile Area

The West Waste Pile Area (WWPA), located south of the NDWPA and further identified on Plan 2 of the Record Drawing Set, was to be remediated by construction of a 24-inch thick remedial soil cover.

In May 1989, following tree clearing by Christen's Tree Service, LCGC graded portions of the WWPA to promote positive stormwater runoff from the area. LCGC utilized an irrigation spray system and water truck to continuously wet the area to be graded with water from the Industrial Canal prior to and during the grading operation. Grading of the WWPA was completed on May 7, 1989.

On May 8, 1989 LCGC commenced placement of the minimum six-inch thick sand cover with sand dredged from the Borrow Pit. From July 12, 1989 to August 11, 1989, LCGC constructed a 15-inch thick clay cover on the WPPA sand cover. From August 12, 1989 to September 21, 1989, LCGC placed the three-inch thick topsoil cover and seeding. The WWPA remedial soil cover construction was completed on September 21, 1989.

4.4.6 Papermill Effluent Stage 1 Trough

The original remedial design for the Papermill Effluent Stage 1 Trough (Papermill Trough), located south of the WWPA and further identified in Plan 2 of the Record Drawing Set, was to abandon and backfill the Papermill Trough and then excavate, install and backfill a new Transite®

stormwater sewer south of the trough for Site stormwater drainage. Shortly after commencement of field remedial construction activities this design was revised with USEPA RPM approval to provide for construction of a drainage swale in the location of the existing trough.

On May 16, 1989 LCGC began backfilling the Papermill Trough with sand from the Borrow Pit. Sand backfill was graded to form a swale flowing from west to east. The swale was lined with Phillips Supac® 4NP geotextile followed by placement of a 12-inch thick riprap stone cover. Stormwater pumped from the Plant's Papermill effluent lines now flows along the swale and enters the wastewater treatment system through a culvert pipe connected to the Catch Basin as shown on Plan 5 and Plan 7 of the Record Drawing Set and discussed below.

On September 26, 1989 LCGC excavated, removed and replaced a former Transite® culvert at the east end of the Papermill trough with 44 linear feet (LF) of 24-inch diameter Class III concrete culvert pipe with flared end section. Culvert replacement was performed by LCGC personnel equipped with Level C personal protective clothing and monitored by USEPA's on-Site representative. All excavated waste material/soil was transported to and disposed of in the Mixing Basin Stages 2/8. The 24-inch diameter Class III concrete culvert was installed and backfilled with sand from the Borrow Pit. A 20-feet wide Class I gravel road as specified in Attachment B of the Amended Work Plan, was later constructed over the culvert. Papermill Trough remedial construction activities were completed by LCGC on September 26, 1989.

4.4.7 Papermill Black Ditch Area

The Papermill Black Ditch Area (PBDA) located south of the Papermill Effluent Stage 1 Trough and further identified on Plan 2 of the Record Drawing Set, was remediated by construction of a 24-inch thick remedial soil cover.

In May 1989, LCGC utilized a dozer to grade sand hauled to the PBDA from the Borrow Pit to achieve the required minimum six-inch depth. From August 11, 1989 to late October 1989, LCGC imported clay and constructed a 15-inch thick clay cover over the PBDA sand cover. Clay cover construction was followed by placement of a three-inch thick topsoil cover and seeding . Construction of the PBDA remedial soil cover was completed in April 1990.

4.4.8 Future Miscellaneous Waste Disposal Area

The Future Miscellaneous Waste Disposal Area (FMWDA) located south of Mixing Basin Stage 3 and identified on Plan 2 of the Record Drawing Set, was intended to remain open after completion of remedial activities to receive future non-asbestos containing Plant waste materials. The banks of the FWMDA were to be graded to a 2:1 slope and covered with the typical 24-inch thick remedial soil cover.

Following the change of procedure from grading ACM to grading by backfilling with sand as specified in the Work Plan Supplement, it became apparent that the capacity of the FMDWA after remediation would be of little use to Schuller for future plant waste disposal. Accordingly, it was agreed with USEPA that the FMWDA would be backfilled with sand and a 24-inch thick remedial soil cover constructed over it. In addition it was agreed that the gravel roadways along the south and east perimeter of the FMWDA would be deleted and replaced with remedial soil cover because these roads would no longer be necessary for future plant needs.

On June 26, 1989, LCGC commenced backfill of the FMWDA with sand from the Borrow Pit. Grading of the sand in the FMWDA was completed on September 20, 1989. From October 18, 1989 to October 28, 1989, LCGC placed a 15-inch thick compacted clay cover on the FMWDA. From October 28, 1989 to May 29, 1990, a three-inch thick topsoil cover and seeding were placed. The FMWDA remedial soil cover construction was completed on May 29, 1990.

4.4.9 Asbestos Disposal Pit

The Consent Decree specified that closure of the former Asbestos Disposal Pit, identified on Plan 2 of the Record Drawing Set, would be completed by June 30, 1989. This area was to be provided with a 24-inch thick remedial soil cover.

Prior to June 30, 1989, the Asbestos Disposal Pit was partly filled with sludge dredged from the Black Ditch and trees, shrubs and miscellaneous debris generated during Site clearing and grubbing activities. In addition, several truck loads of dry Plant waste and ACM from the Schuller Plant were disposed of in the former Asbestos Disposal Pit. Dry plant waste included roofing and non-ACM pipe insulating material, and ACM consisting of Transite® building materials removed from on-Site structures. ACM was placed and sealed in double 6-mil polyethylene bags designed for ACM disposal.

On May 17, 1989, the Schuller Plant and LCGC discontinued disposal of debris and ACM in the former Asbestos Disposal Pit. LCGC began closure of the former Asbestos Disposal Pit by backfilling with sand from the Borrow Pit. An average thickness of ten to fifteen feet of sand was placed in the pit to provide positive surface water drainage. Following sand placement and grading, 15 inches of clay soil was placed. Three inches of topsoil then was placed on the clay cover and graded. Finally LCGC spread seed and fertilizer to complete the soil cover.

Completion of the former Asbestos Disposal Pit closure occurred on June 30, 1989.

4.4.10 Black Ditch Area

The Black Ditch Area, identified on Plan 2 of the Record Drawing Set, was remediated partly with a 24-inch thick remedial soil cover with vegetation, and partly with a 24-inch thick Class I gravel roadway. Sloped areas were first backfilled with sand and the sand graded to slopes of 2:1 or 2.5:1. Flat surface areas were covered with a minimum of six inches of sand, except where roadway construction was specified. The sand was covered by at least fifteen inches of clayey soil, three inches of topsoil and seeded in accordance with Attachment B of the Amended Work Plan. The Black Ditch area remedial soil cover construction activities were performed by LCGC from October 2, 1989 to April 6, 1990.

The 20-foot wide Class I gravel roadway designated for the Black Ditch Area was constructed as specified in Attachment B of the Amended Work Plan. LCGC began roadway construction on October 6, 1989 and completed construction on October 7, 1989.

4.4.11 Active Miscellaneous Waste Disposal Pit

The Active Miscellaneous Waste Disposal Pit (AMWDP) located near the southeast corner of the Site and identified on Plan 2 of the Record Drawing Set, was not originally scheduled to be remediated under the Amended Work Plan. Historically, it was believed that the AMWDP was used for disposal of miscellaneous non-asbestos containing Plant wastes. Under the Consent Decree and Amended Work Plan, materials in the AMWDP were to be sampled during the remedial construction program to verify whether or not the AMWDP contained ACM.

On October 24 and October 25, 1988, CCJM representatives collected miscellaneous sludge/soil samples from the AMWDP under Schuller's OSR direction as discussed in Section 11.2. This sampling was conducted jointly with IEPA. Analytical data for the samples collected by CCJM confirmed that ACM was present in the AMWDP. On December 18, 1989 Schuller submitted to the USEPA a proposal to remediate the AMWDP. The remedial design called for:

- construction of a 24-inch thick remedial soil cover, with vegetation, on the side slopes; and

- placement of either a minimum of three feet of plant miscellaneous solid waste and daily clay cover or 24 inches of sand on the AMWDP base.

The USEPA RPM issued verbal approval for the AMWDP remedial design at the December 20, 1989 weekly Site meeting. Earlier, from July 13, 1989 to August 7, 1989, LCGC placed a minimum of six inches of sand cover on the AMWDP side slopes and base under the direction of the OSR pending approval of the final cover design. The sand cover allowed Level D personnel protective equipment to be used in this area as further described in Section 8.2. Following USEPA formal approval of the final cover design, LCGC placed a 15-inch thick clay cover on the AMWDP side slopes between December 20, 1989 and January 31, 1990. On February 20, 1990, LCGC constructed a gravel access road from the eastern most Site road into the AMWDP to facilitate Plant access. Following construction of the access road, the Plant discontinued Plant dry waste disposal operations in Mixing Basin

Stages 6 and 7 as noted in Section 4.4.13 and commenced disposal of the Plant dry waste materials on the sand covered base of the AMWDP. LCGC constructed a three-inch thick topsoil cover in the AMWDP side slopes in May 1990. On May 8, 1990, LCGC graded the Plant waste disposed of on the AMWDP base to achieve a minimum three feet of cover over the base. An additional six-inch thick sand cover was placed over the AMWDA base following grading of the Plant waste to prevent migration of waste from the AMWDP due to wind. Remedial construction activities in the AMWDP were completed on May 8, 1990. As of May 8, 1990, the Plant continued to dispose of Plant waste in the AMWDP with daily clay cover.

4.4.12 Southeast Ditch

The Southeast Ditch, located in the southeastern portion of the Site and further identified on Plan 2 of the Record Drawing Set, was filled with Plant miscellaneous dry waste materials. Filling of the Southeast Ditch was performed by Plant personnel prior to the start of on-Site remedial construction activities in October 1988.

LCGC constructed a 24-inch thick remedial soil cover on the Southeast Ditch Area in October 1989.

4.4.13 Mixing Basin Stages 2/8, 6 and 7

Mixing Basin Stages 2/8 and 6 and 7, further identified on Plan 2 of the Record Drawing Set, were formerly used by the Plant as part of a process wastewater treatment system. Mixing Basins Stages 2/8 and 6 and 7 were to be filled with Plant waste and covered with a 24-inch thick remedial soil cover.

In early March 1989, the Plant was directed to dispose of Plant dry waste materials in Mixing Basin Stages 2/8 and continued to do so until September 1989 when the waterway was closed and completely backfilled. The Plant then commenced backfilling of Mixing Basin Stages 6 and 7 in a similar fashion. On February 20, 1990, the Plant discontinued disposal of dry plant waste in this area and the remainder of Mixing Basin Stages 6 and 7 was backfilled with sand from the Borrow Pit and asbestos-containing sludge dredged from the Catch Basin and Mixing Basin Stages 3, 4, and 5, as discussed in Section 5.2.

Sand was graded by LCGC to promote positive stormwater runoff from Mixing Basin Stages 6 and 7. A drainage swale for surface stormwater drainage was constructed through Mixing Basin Stage 6 to convey surface stormwater runoff to the Settling Basin as specified in Attachment B of the Amended Work Plan and identified on Plan 7.

Following the completion of backfilling and rough grading, Mixing Basin Stages 6 and 7 and 2/8 were covered with an additional six inches of sand from the Borrow Pit. From March 2 to April 27, 1990, LCGC placed a minimum 15-inch thick compacted, clayey soil cover on Mixing Basin Stages 2/8 and 6 and 7. From April 23 to May 1, 1990, LCGC placed a three-inch topsoil cover on the clay cover and fertilized and seeded the area. Remedial construction activities in Mixing Basin Stages 2/8 and 6 and 7 were completed on May 1, 1990.

4.4.14 East Border Area

The East Border Area, located along the eastern boundary of the Site and further identified on Plan 2 of the Record Drawing Set, was not scheduled to be remediated under the Amended Work Plan. In December 1988, LCGC constructed a stormwater collection and seepage basin in the East Border Area as specified in Attachment B of the Amended Work Plan to prevent stormwater runoff migration away from the Site.

As discussed in Section 11.4, representative samples of miscellaneous surficial materials collected from the areas adjacent to the stormwater collection and seepage basin on February 7, 1990 by USEPA, IEPA and CRA confirmed the presence of ACM. In addition, surface water samples collected by CCJM during the quarterly Surface Water Monitoring Program in 1989 confirmed an exceedance of the 7.1 million fibers per liter (MFL), fibers greater than 10 μm in length, action level for asbestos fibers. To address these concerns, on July 31, 1990 a proposal to remediate the East Border Area and stormwater collection and seepage basin was submitted to USEPA by Manville as part of the Second Work Plan Supplement.

In September 1990, LCGC pregraded existing sand in the East Border Area, partially backfilling the previously constructed swale and stormwater collection and seepage basin. Sand was also hauled from the Borrow Pit and placed on the East Border Area to complete backfilling and grading of the swale and basin. From late September to late October 1990, a 24-inch thick remedial soil cover was constructed by LCGC on the East Border Area. The East Border Area remedial soil cover construction was completed on November 3, 1990.

4.4.15 Sludge Disposal Pit

In accordance with the Consent Decree, representative samples of materials contained in the Sludge Disposal Pit, located on Plan 2 of the Record Drawing Set, were to be collected and analyzed to verify the presence or absence of ACM. On October 24 and October 25, 1988, CCJM collected representative samples of sludge and soil from the Sludge Disposal Pit under OSR direction, as discussed in Section 11.2. Analytical data for the samples collected verified the presence of ACM in the Sludge Disposal Pit. In response to these findings, the Sludge Disposal Pit was backfilled with miscellaneous plant dry waste and sand and a 24-inch thick remedial soil cover was constructed over the pit.

Prior to closure, miscellaneous debris and ACM resulting from rough grading activities along the southern bank of the Settling Basin were placed in the Sludge Disposal Pit to promote placement of the remedial soil cover on the bank as well as to provide backfill for the Sludge Disposal

Pit. On May 13, 1989, LCGC began backfilling the pit with sand from the Borrow Pit. Sand backfill was graded with a bulldozer to promote positive drainage of surface stormwater runoff. Existing culvert piping located on the western end of the Sludge Disposal Pit as identified in Attachment B of the Amended Work Plan was abandoned and backfilled with sand and miscellaneous materials during backfilling of the pit. Clay cover placement began on August 17, 1989. Topsoil cover placement began on September 27, 1989. Seeding and fertilizing of the Sludge Disposal Pit remedial soil cover was completed in October 1989.

4.4.16 South Border Area/South Central Areas

The South Border Area and South Central Areas (east and west) were to receive a 24-inch thick vegetative remedial soil cover. On May 16, 1989 LCGC began placement of the sand cover on the South Border Area and continued onto the South Central Areas. Minor rough grading along the south sloped portion of the South Border Area, as approved by USEPA, was performed on the existing material by a backhoe prior to sand cover placement on the sloped areas. Rough grading was necessary on the south slope to facilitate placement of the remedial soil cover at a grade of 2:1. LCGC began clay cover placement on the South Border area on August 9, 1989 and on the South Central Areas on August 16, 1989. Clay cover placement was performed in both areas simultaneously beginning August 16, 1989. Topsoil cover placement began on September 15, 1989 in the South Border Area and upon completion continued to the South Central Areas. Seeding and fertilizing of the South Border Area and the South Central Areas began on September 17, 1989. Remedial soil cover construction on the South Border Area and South Central Area - East was completed on October 10, 1989. Remedial soil cover construction on the South Central Area - West was completed in April 1990.

4.4.17 East Ditch Area

The East Ditch Area , located between the Collection Basin and East Border Areas and further identified on Plan 2 of the Record Drawing Set, was to be remediated by construction of a 24-inch thick vegetative remedial soil cover.

Prior to closure of the East Ditch Area, water levels in the East Ditch were controlled by two 30-inch diameter Transite® culverts at the north end of the East Ditch Area which directed waters from the East Ditch Area to the Industrial Canal. Closure of the East Ditch Area, included backfilling over the two culverts. To maintain flowage of waters from the East Ditch Area and alleviate potential seepage pressures, LCGC installed three 10-inch diameter perforated poly vinyl-chloride (PVC) pipe lines, of varying lengths, into the ends of each 30-inch diameter Transite® culvert (total of six pipes). The PVC pipes were further backfilled with 3-inch diameter crushed limestone gravel, overlain by Supac® 4NP geotextile fabric to form a seepage drain. The geotextile fabric, stone and pipelines then were backfilled with sand from the Borrow Pit. Three of the six PVC pipes later were incorporated with the Collection Basin level control drains as discussed in Section 6.8.

LCGC began placement of the sand cover over the East Ditch Area in April 1989, following completion of tree clearing operations and backfilling of the East Ditch Area with solid non-asbestos containing Plant waste. On May 22, 1989 clay cover placement on the East Ditch Area commenced. Topsoil cover placement on the East Ditch Area commenced on July 15, 1989 followed by seeding and fertilizing. The East Ditch Area remedial soil cover was completed on October 12, 1989.

4.4.18 Northeast Corner Area

The Northeast Corner Area located at the eastern end of the Industrial Canal and further identified on Plan 2 of the Record Drawing Set, was to be remediated with a 24-inch thick vegetative remedial soil cover. Attachment B of the Amended Work Plan specified only a portion of the Northeast Corner Area was to be remediated. However, while excavating to install Site drainage in accordance with the original Site plans, it was determined that ACM was present beyond the original design remediation limits. Sampling and analysis of the material by CCJM confirmed the presence of ACM. Subsequently, Schuller's OSR directed LCGC to extend the soil cover eastward to the eastern most fence line. LCGC began sand placement in the Northeast Corner Area in April of 1989. Clay cover placement began on October 9, 1989 and topsoil cover placement began on November 6, 1989. All seeding and fertilizing in the Northeast Corner Area was completed by April 20, 1990. The final limits of the Northeast Corner remedial soil cover are shown on Plan 6 of the Record Drawing Set.

4.4.19 Active Wastewater Treatment System Slopes

Water bodies that formed the Active Wastewater Treatment System for on-going Plant operations, including the Catch Basin, and the Mixing Basin Stages 3,4 and 5, were to be remediated by initially dredging materials stored within them followed by construction of a remedial soil cover along the slopes of the water bodies. Dredging of the water bodies is discussed in Section 5.0 of this report. The following discussion pertains to the remedial soil cover along the slopes.

LCGC began placement of a minimum 12-inch thick sand cover, geotextile layer and 12-inch thick riprap stone cover along the Settling Basin slopes on June 22, 1990. The riprap slope protection along the south bank of the Settling Basin was supported at the toe of the slope by placement of 4-foot x 4-foot x 3-foot prefabricated concrete blocks as shown on Plan 9 and discussed in Section 6.9. Concrete blocks were placed along the toe of the Settling Basin south slope from August 24 to August 31, 1989 using a backhoe. Riprap cover along the Settling Basin banks was completed by August 31, 1989.

On August 15, 1989 LCGC began placing sand along the Catch Basin and Mixing Basin Stages 3, 4 and 5 slopes. In addition to building 2:1 slopes above the existing water level of the Catch Basin and Mixing Basin Stages 3,4 and 5, sand fill was utilized to build slope support below the water level as dredging of the sludge from these water bodies, discussed in Section

5.0, had resulted in vertical banks below the water surface. The sand fill below the water level was placed to provide adequate anchorage for the remedial soil cover above. Riprap and geotextile placement along the banks of the Catch Basin and Mixing Basin Stages 3,4 and 5 commenced on September 9, 1989. All riprap placement along the Catch Basin and Mixing Basin Stages 3, 4 and 5 slopes was completed on September 27, 1989.

As specified in Attachment B of the Amended Work Plan and as shown on Plan 7 of the Record Drawing Set, the sloped areas not covered with riprap were remediated by construction of a 24-inch thick vegetative soil cover. LCGC began placing the clay cover on the Settling Basin slopes on September 30, 1989 and completed the Settling Basin slope vegetative soil cover by May 1990.

LCGC began clay placement on the Catch Basin and Mixing Basin Stages 3,4 and 5 slopes on October 11, 1989. Topsoil cover placement began in April 1990. Vegetative soil cover construction on the slopes of the Catch Basin and Mixing Basin Stages 3, 4 and 5 was completed by May 1990.

4.4.20 Industrial Canal and Pumping Lagoon

The south and west banks of the Industrial Canal and banks surrounding the Pumping Lagoon were not designated to be remediated under the Consent Decree or Amended Work Plan. A miscellaneous bulk sampling program conducted by representatives of

USEPA, IEPA and CRA on February 7, 1990 verified the presence of ACM along the banks of the Pumping Lagoon and south and west banks of the Industrial Canal. Schuller developed the Second Work Plan Supplement to address the remediation of these additional areas as well as to address ACM present in the East Border Area, West Parking Area, Semi-trailer Staging Area and areas south of the Borrow Pit.

Under the Second Work Plan Supplement, the Pumping Lagoon banks, Industrial Canal banks and adjacent areas where ACM was found were to be remediated by construction of a 24-inch thick remedial soil cover consisting of a vegetative clayey soil cover with riprap cover at the water/soil cover interface.

LCGC commenced placement of a six-inch to 12-inch thick sand cover on the Industrial Canal south and west banks and adjacent flat areas on August 13, 1990. Sand cover placement on the Pumping Lagoon banks and adjacent areas began on August 30, 1990. During sand cover placement, several existing subsurface culvert pipes along the south banks of the Industrial Canal and Pumping Lagoon were identified and extended by installation of additional lengths of PVC culvert piping or corrugated plastic culvert piping to meet the final grade of the remedial soil cover. The culverts are used to convey subsurface seepage from the Site and/or convey stormwater from the northern most Plant structures to the Pumping Lagoon and Industrial Canal. These culverts are further identified on Plans 4 and 6 of the Record Drawing Set.

LCGC commenced placement of the riprap cover and geotextile along the water/soil cover interface of the Industrial Canal south and west banks and Pumping Lagoon banks on October 19, 1990. On October 22, 1990 LCGC began clay cover placement on the Industrial Canal south and west banks and Pumping Lagoon banks. Clay cover along the Pumping Lagoon banks was completed on November 2, 1990. Industrial Canal south and west banks clay cover was completed on November 12, 1990. LCGC began placement of the 3-inch thick topsoil cover over the Pumping Lagoon and Industrial Canal banks on November 13, 1990. The vegetative soil cover on these areas was completed by November 26, 1990.

To alleviate stormwater ponding immediately south of the Pumping Lagoon, USEPA approved the construction of a riprap stone lined spillway, as identified on Plan 4 of the Record Drawing Set. LCGC excavated the spillway structure through the remedial soil cover along the south side of the Pumping Lagoon on November 27, 1990. Clay and topsoil were temporarily removed to facilitate access to the existing base material/soils. All base material/soils excavated to construct the spillway was placed in double 6-mil polyethylene bags designed for ACM. All excavated materials were treated as ACM. Bagged materials were disposed of off-Site along with ACM removed during surficial ACM cleaning of Plant areas as discussed in Section 7.0. Following removal of the excavated materials, the clay soil cover was reconstructed followed by placement of a geotextile layer and stone cover. All riprap spillway construction was completeed on November 27, 1990.

4.4.21 Borrow Pit

The Borrow Pit, located in the northwest portion of the Manville Plant Site and further identified on Plan 2 of the Record Drawing Set, was utilized during the course of the remedial soil cover construction as the borrow site for sand fill material. In June 1990, USEPA and CRA representatives identified the presence of ACM in areas along and adjacent to an existing perimeter roadway. To address these areas, Amendment A, Second Work Plan Supplement (Amendment A) was submitted to USEPA by Manville. Under Amendment A, the Borrow Pit perimeter road and adjacent areas were to be remediated by:

- a surficial cleaning of ACM from the Borrow Pit eastern sloped area;
- construction of a six-inch thick vegetative topsoil cover along the Borrow Pit eastern sloped area to prevent erosion of the roadway bank;
- construction of a 24-inch thick, 14-foot wide Class II gravel roadway over the existing perimeter roadway; and
- construction of a 24-inch thick vegetated remedial soil cover on areas adjacent to the roadway.

The gravel roadway construction and surficial clean-up of ACM in the Borrow Pit are discussed in Sections 4.5 and 7.0, respectively. The soil cover construction is discussed below. In early January 1991, following completion of surficial ACM removal along the eastern slopes of the Borrow Pit, sand cover placement on the Borrow Pit perimeter areas commenced. Fill sand, in addition to the six-inch minimum base depth, was placed along the eastern sloped area of the Borrow Pit to develop slopes of at least 2:1. On February 12, 1991 LCGC began clay cover placement on the areas adjacent to the Borrow Pit perimeter roads. On February 26, 1991 LCGC commenced placement of the topsoil cover, seed and fertilizer. All vegetated soil cover construction along the Borrow Pit perimeter areas was completed by May 31, 1991.

4.4.22 Area Z

In accordance with the USEPA approved Third Work Plan Supplement portions of Area Z, further identified on Plan 4 of the Record Drawing Set, were remediated by construction of a 24-inch thick remedial soil cover. On July 18, 1991 LCGC cut and cleared several trees from Area Z to facilitate placement of the remedial soil cover. On July 22, 1991 LCGC hauled and placed a six-inch minimum depth sand cover on Area Z. On July 23 and July 24, 1991 LCGC hauled and placed a 15-inch thick clayey soil cover over the sand cover. Topsoil was placed by LCGC on August 3, 1991 followed with final grading and seeding. The Area Z vegetative remedial soil cover was completed by August 19, 1991.

4.5 GRAVEL COVER AND GRAVEL ROADWAYS

On-Site remediation areas subject to Plant vehicular traffic during and subsequent to Site remediation including the northern Site perimeter access road, Black Ditch area access road and active waste water treatment system access roads, would be remediated by construction of a composite 24-inch thick granular cover. In addition to the Site roadways, the storage area located west of the South Central Area - West was remediated by construction of a 24-inch thick granular cover. The Semi-Trailer Staging Area located west of the Pumping Lagoon was remediated by the construction of a 12-inch thick granular cover. These areas were remediated in accordance with the Second Work Plan Supplement.

A Class I granular cover was typically constructed on heavily traveled Site areas and a Class II granular cover was typically constructed on lightly traveled Site areas. The Class I granular cover was comprised of a minimum 12-inch thick sand sub-base, 8-inch thick compacted Illinois Department of Transportation, Standard Specification for Road and Bridge Construction (IDOT) coarse aggregate base and 4-inch thick compacted coarse aggregate surface. The Class II gravel cover was comprised of a 14-inch thick sand sub-base, six-inch thick compacted coarse IDOT aggregate base and 4-inch thick IDOT coarse aggregate surface. Typical as-constructed cross-section views of the Class I and Class II gravel covers for the Site are presented on Plan 13 of the Record Drawing Set. Roadways and other areas constructed in a Class I or Class II fashion are also identified on Plan 13. All gravel cover was compacted by LCGC's smooth vibratory drum roller to at least 95% Standard Proctor density. Compaction of roadway materials was confirmed by

O'Brien field inspectors. Gravel cover field densities, as reported by O'Brien are presented in Appendix C.

The southern most Site roadway was remediated with a Class I gravel cover. Following the recommencement of field activities at the Site in February 1989, the drainage ditches originally proposed in Attachment B of the Amended Work Plan were deleted to minimize on-Site excavation. To facilitate adequate Site drainage, this roadway was graded to allow surface stormwater runoff to flow positively from west to east. All south road construction was completed in April 1990.

In addition to active Site areas remediated by Class I Class II or 12-inch thick gravel cover, the Plant requested placement of a six-inch thick compacted coarse aggregate road from the northern end of the eastern Site road to the 16-foot wide double swing gate along the eastern fence line as shown on Plan 6. This roadway would allow for continued Plant maintenance of the gate and adjacent beach areas. To provide additional stability through the area, an eight-inch to ten-inch thick compacted coarse aggregate surface was placed following completion of the 15-inch thick clay cover in April, 1990 by LCGC in lieu of the six-inch thick compacted coarse aggregate road.

Under the Second Work Plan Supplement, the eastern most Site access road was remediated by construction of a Class I gravel cover as discussed above. Eastern Site roadway construction was completed in September 1990. Also addressed in the Second Work Plan Supplement was the remediation of the contractor's equipment Staging Area located west of the South Central Area - West and the Semi-trailer Staging Area located west of the Pumping Lagoon. The contractor's equipment staging area was remediated by construction of a Class I gravel cover over the area as shown on Plan 5 of the Record Drawing Set. The Semi-Trailer Staging Area was remediated by construction of a 12-inch thick gravel cover. Prior to gravel cover placement, existing shingle tabs in the Semi-Trailer Staging Area were graded using a road grader to promote positive surface stormwater drainage. Sand from the Borrow Pit was used to fill in and grade low areas. Following subbase preparation, an 8-inch thick IDOT coarse aggregate base was placed. A 4-inch thick IDOT coarse aggregate surface then was placed over the base gravel. Both gravel layers then were compacted to at least 95% of Standard Proctor density using a smooth-drummed vibratory roller. Gravel cover on both areas was completed in October 1990.

Under Amendment A of the Second Work Plan Supplement, the Borrow Pit perimeter roadway was to be remediated by construction of a 14-foot wide Class II gravel cover. The Borrow Pit perimeter roadway gravel cover was constructed in conjunction with a 24-inch thick remediated soil cover on adjacent areas as discussed in Section 4.4.21. All Borrow Pit roadway construction was completed by LCGC in February 1991.

To allow Plant access to the existing sand stockpiles in the Borrow Pit, an 8-inch thick IDOT coarse aggregate base access road was constructed across the remediated soil cover along the North side of the Borrow Pit. Access road construction was completed in July 1991.

4.6 BITUMINOUS SURFACE TREATMENT

4.6.1 Patching and Sealing

In accordance with the Second Work Plan Supplement the bituminous pavement area immediately west of the Site, further identified as the West Parking Area on Plan 2 of the Record Drawing Set, was remediated by patching areas of broken bituminous pavement with hot mix bituminous material and sealing cracked areas with hot tar sealant. During December 1990, LCGC subcontracted Skokie Valley Asphalt Company (Skokie), Inc. of Grayslake, Illinois to perform all bituminous patching. Midwest Tar Sealer Company (Midwest) of Itasca, Illinois was subcontracted by Skokie to perform all hot tar sealing. Areas requiring either sealing or patching were field identified by Schuller's OSR and agreed to with the USEPA OSC.

Patching of large areas included trimming existing bituminous material with an air chisel to expose a clean edge, thus facilitating a better bond between the new and old bituminous material. All bituminous cuttings were removed from the patch area and disposed of in the AMWDP. Following removal and disposal of the bitiminous cuttings, the base of the patch area was compacted with either a smooth drum vibratory roller or plate tamper. A hot bitiminous surface cover then was placed and compacted with the smooth drum vibratory roller.

Prior to sealing small cracks, Midwest cleaned mud and water out from each crack using compressed air. Following cleaning of the cracks, hot tar was poured into the cracks and allowed to cure.

All patching and sealing of the west parking area was completed in December 1990.

4.6.2 Bituminous Surface Cover

In accordance with the USEPA approved Third Work Plan Supplement, portions of Area Y and Area Z were remediated by construction of a composite six-inch thick gravel and two-inch thick bituminous cover. Following clearing of existing trees, bushes and miscellaneous debris from Area Y in July 1990, LCGC excavated an 8-inch deep "key" along an existing bituminous roadway on the northern and western portions of Area Y. Water was applied by LCGC to suppress dust during the excavation process. All excavated material was thinly spread over adjacent areas specified to be covered by pavement. Following completion of excavating, LCGC placed sand imported from the Borrow Pit on the work area for sub-base contouring and to provide positive surface stormwater runoff. A minimum six-inch thick compacted IDOT crushed aggregate surface layer was placed following the sand placement and compacted to a minimum of 95% of Standard Proctor density. Compaction of the crushed aggregate surface was tested by O'Brien field inspectors to verify the compaction achieved. Results of the field density tests, as reported by O'Brien, are presented in Appendix C.

Concurrent with the Area Y gravel cover installation, LCGC dismantled portions of a former railroad line in Area Z. All railroad trackage removed was thoroughly cleaned of visible debris using water from LCGC's water wagon prior to staging at the perimeter of the area. The Plant transported the cleaned railroad trackage to other Plant areas for future use. Following completion of the gravel cover in Area Y and removal of the railroad trackage from Area Z, LCGC placed a minimum six-inch thick compacted gravel cover on portions of Area Z. Sand fill was used to grade the sub-base to promote positive drainage of surface stormwater runoff away from existing Plant structures prior to gravel placement. All gravel cover construction on Area Y and Area Z was completed on August 15, 1991.

On August 16, 1991, LCGC administered soil sterilant to the gravel cover along the existing fence lines and/or building walls in Area Y and Area Z. Following application of the soil sterilant, Baker mobilized and applied asphaltic tack coat to existing bituminous surfaces. On August 20, 1991 and August 21, 1991, Baker placed a minimum 2-inch thick bituminous surface coarse on Area Y and Area Z and compacted the cover to a minimum of 93% of American Association of State Highway and Transportation Officials (AASHTO) T209 density. Compaction of the bituminous layer was verified in the field by O'Brien field inspectors. Approximately 17,000 square yards of 2-inch thick bituminous surface cover was placed by Baker. All bituminous surface cover work was completed on August 21, 1991.

5.0 WASTEWATER TREATMENT SYSTEM SLUDGE DREDGING

5.1 GENERAL

In accordance with Article V(1)(g) of the Consent Decree and Section 2.1.g of the Amended Work Plan, a Sludge Dredging Plan (Attachment D) was implemented as part of the remedial action at the Site. The Sludge Dredging Plan included:

- the discontinuance of systematic dredging activities in the Settling Basin (33-acre pond);

- a one-time dredging of all waterways leading to the Settling Basin to a depth two feet greater than the maximum depth typically dredged by the Plant; and

- installation of concrete monuments (benchmarks) to serve as reference points in future dredging operations.

In addition to the above, a waterway toe of slope delineation system was developed and installed to serve as reference points in future dredging operations.

5.2 SLUDGE DREDGING

On April 4, 1989, Liquid Waste Technology, Inc. (LWT) of Somerset, Wisconsin mobilized a LWT Pit Hog® hydraulic dredging system to the Site to commence dredging sludge from the Catch Basin. To facilitate set up of the dredging equipment, the outfall of the Catch Basin was temporarily blocked to raise the water level of the waterway. The dredging equipment was placed in the Catch Basin using a backhoe. Discharge hoses for the dredging equipment then were attached and directed into Mixing Basin Stage 6 and 7. The former passage way through the dike between Mixing Basin Stage 5 and Mixing Basin Stages 6 was backfilled by LCGC with sand from the Borrow Pit and wastewaters were redirected from Mixing Basin Stage 5 to the Settling Basin through a newly installed 24-inch diameter concrete culvert pipe with flared end sections as shown on Plan 7 of the Record Drawing Set.

Dredging of the Catch Basin was conducted in a systematic fashion. Using the Pit Hog®, LWT dredged in a north-south direction as well as a east-west direction to remove asbestos containing sludge from the Catch Basin to within three to five feet of the existing shore line. Attachment D of the Amended Work Plan originally specified placement of the sludge from the dredging operations into the Settling Basin. USEPA subsequently approved placement of the sludge dredged from the Catch Basin and Mixing Basin Stages 3, 4 and 5 into Mixing Basin Stages 6 and 7 for backfill as part of closure of these basins.

Final dredge depths were verified by the OSR at several locations in the Catch Basin by surveying the top of water elevation of the Catch Basin and measuring the depth of dredging from the top of the water. Upon acceptance of the work by the OSR, LWT transferred the dredging equipment to Mixing Basin Stages 3, 4 and 5. Sludge dredged from Mixing Basin Stages 3, 4 and 5 was placed into Mixing Basin Stages 6 and 7 for backfill, as discussed above. Upon completion of dredging operations, the dredge depth was verified by the OSR as discussed above. LWT completed dredging of the wastewater treatment system on July 13, 1989. All dredging equipment and discharge hoses were thoroughly decontaminated with water supplied by LCGC's water truck on Site adjacent to the Catch Basin and Mixing Basin Stage 3 prior to demobilization on July 13, 1989. Decontamination waters were allowed to drain into the Catch Basin and Mixing Basin Stage 3.

The USGS elevations of the final dredge depths for the Catch Basin and Mixing Basin Stages 3, 4 and 5 are presented in Table 5.1.

5.3 BENCHMARKS

To ensure that future removal of sludge from the wastewater treatment system does not exceed the depth dredged by LWT, the Consent Decree specified that future dredging may not exceed a depth two feet above LWT's dredge depths. To facilitate accurate depth determinations and provide future reference, six permanent benchmarks (BM-1 through BM-6) were constructed at locations adjacent to the Catch Basin and Mixing Basin Stages 3, 4 and 5 as shown on Plan 7 of the Record Drawing Set. A typical

TABLE 5.1

AVERAGE ELEVATION OF FINAL DREDGE DEPTHS
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS -MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Waterway	*Average Elevation of Final Dredged Depth*[1]
Catch Basin	600.8
Mixing Basin Stage 3	599.5
Mixing Basin Stage 4	598.8
Mixing Basin Stage 5	597.9

[1]Measured from United States Geologic Survey Mean Sea Level.

benchmark consisted of a 5-foot long section of 4-inch diameter Schedule 40 steel pipe driven vertically into the remedial soil cover to a depth of approximately 4.5 feet. The pipe was then filled with concrete and encased at the surface by a 6-inch thick triangular shaped concrete pad. Benchmarks were constructed on May 23, 1990 following placement of the remedial soil cover on the surrounding areas. Benchmark details are presented on Plan 14 of the Record Drawing Set. Reference elevations and locations of each benchmark were established by LCLS on May 29, 1990. Table 5.2 presents the United States Geologic Survey (USGS) elevations and local grid locations for each benchmark.

5.4 POND TOE OF SLOPE DELINEATIONS

In addition to the permanent benchmarks installed as discussed in Section 5.3, a series of 2-inch diameter concrete filled steel posts were installed at locations off-set from the corners of the Catch Basin and Mixing Basin Stages 3, 4 and 5. These posts identify the approximate location of the toe of slope of sand backfill in each water body. A rope and float (buoy line) system was fabricated to be hung from these posts to assist in identifying the toe of slope and protect the slopes from being undermined during future dredging operations. The buoy line system is further discussed in the Site Operations and Maintenance Manual. All buoy line system fabrication and installation was completed in May 1990.

TABLE 5.2

LOCATION AND ELEVATION OF PERMANENT BENCHMARKS
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS -MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Benchmark	*Northing*[1,2]	*Easting*[1,2]	*USGS Elevation*[1,3]
BM-1	8,317.702	11,089.207	615.92
BM-2	8,375.659	11,276.068	615.42
BM-3	8,553.156	11,314.541	615.22
BM-4	8,773.382	11,299.912	613.27
BM-5	8,855.549	11,033.783	611.85
BM-6	8,969.921	11,184.555	611.10

[1]From Lake County Land Surveying Company Survey, May 29, 1990.
[2]Based on local grid system.
[3]Measured from United States Geologic Survey Mean Sea Level .

6.0 MISCELLANEOUS INSTALLATIONS

6.1 GENERAL

In accordance with the Amended Work Plan and Second Work Plan Supplement, the remedial program at the Site included installation or construction of several Site improvement features facilitating the protection of the remedial soil cover while providing for minimal disruption to on-going Plant operations. Site installations included:

- security fencing;
- subsurface seepage drains;
- enlargement of the Black Ditch pumphouse wet well;
- concrete process and stormwater lines;
- Black Ditch pumphouse effluent piping;
- spillway energy dissipators;
- relocation of power poles and power lines;
- concrete spillway;
- Collection Basin level control drains;
- concrete toe of slope stabilization blocks;
- sheetpile slope retainment wall;
- west perimeter clay berm (drainage ditch);
- Semi-trailer dolly supports;
- culverts and drop inlets;
- warning signs; and
- riprap slope protection and spillways.

The following sections summarize the activities performed in the construction of the above installations.

6.2 SECURITY FENCING

In accordance with the Amended Work Plan, the eastern Site boundary was secured by installation of a six foot high security fence as shown on Plans 6 and 7 of the Record Drawing Set. Security fencing was installed in accordance with Attachment B of the Amended Work Plan by Martens Fencing of Lake Villa, Illinois in October 1988.

In addition to the eastern fence, a six foot high security fence was installed by Martens Fencing along the northern Site boundary between the Industrial Canal and Illinois State Beach Park as shown on Plans 4 and 6 of the Record Drawing Set. Marten's Fencing also installed security fencing between Area Y and the railroad trackage as shown on Plan 5 of the Record Drawing Set to segregate the Site from the former Inland Marine Company area.

Details of the typical six-foot high security fence installation are presented on Plan 14 of the Record Drawing Set.

6.3 SEEPAGE DRAINS

The placement of dike seepage collection drains were specified along the perimeter of the Settling Basin to intercept seepage from the Settling Basin and to maintain the integrity of the sloped remedial soil cover. A review of the original design in the field by Schuller and USEPA representatives concluded that the proposed dike seepage collection drain would not work as intended. In lieu of the original seepage drain design, seepage-collection drains as shown on Plan 13 of the Record Drawing Set were constructed. The typical seepage drain consists of varying lengths of PVC perforated pipeline backfilled with coarse aggregate and overlain by geotextile fabric.

In January 1989, seepage collection drains were installed by LCGC along the invert of a former drainage ditch located on the southern side of the north roadway. These seepage collection drains were constructed to permit backfilling of the ditch with sand and construction of 2:1 slopes north of the Settling Basin and Mixing Basin Stages 2 and 8. Seepage drains were connected to one of three existing culverts leading from the former drainage ditch to the Industrial Canal. The above seepage collection drains and culverts are further identified on Plan 4 and Plan 6 of the Record Drawing Set.

Several other seepage drains were installed, as needed, along the west slope of the Collection Basin and southwest corner of the Borrow Pit. Locations of each seepage drain were determined in the field by the OSR and LCGC. Locations of the discharge points for each seepage drain installed are identified on Plans 4, 6 and 7 of the Record Drawing Set.

6.4 BLACK DITCH

The Black Ditch and Black Ditch pumphouse are part of the active Plant wastewater treatment system. Prior to remedial construction activities at the Site, the Black Ditch was an open channel collection point for the Plant's effluent process waters as they were transferred to the catch basin. Attachment B of the Amended Work Plan specified the Black Ditch to be backfilled and process waters to be carried by pre-cast concrete pipelines. Additionally, the wet well at the Black Ditch pumphouse was to be enlarged to accommodate a larger holding volume.

6.4.1 Pumphouse Wet Well

In early March, 1989, LCGC began excavating sludge and waste material from the Black Ditch to facilitate construction of the wet well extension and placement of a concrete influent pipe as specified in Attachment B of the Amended Work Plan. Sludge excavated from the Black Ditch was transported by dump trucks to the Asbestos Disposal Pit for disposal. Sludge and miscellaneous materials disposed of in the Asbestos Disposal Pit were covered daily with sand from the Borrow Pit.

Following excavation for the wet well, steel sheeting was driven to shore the sides of the excavation due to high water table conditions. Groundwater entering the sheet pile supported excavation was pumped using a 6-inch diesel pump to the Catch Basin to maintain dry working conditions. Subsequent to sheeting installations, a 4-inch thick unreinforced concrete pad (mud mat) was constructed within the excavation, as detailed on Plan 11 of the Record Drawing Set, to reduce the flow of water into the excavation. On March 15, 1989, Scheduled Construction Corporation (SCC) of Lake Villa, Illinois poured a 16-inch thick reinforced concrete base slab for the wet well which further aided in reducing the flow of water into the excavation. SCC subsequently formed and poured the sides of the wet well. A precast 48-inch diameter IDOT Class III concrete pipe was set into the west side of the wet well prior to the pouring of the wall. This pipe was subsequently connected to the Plant's process water and stormwater sewer system.

The north side of the wet well had to be cored to allow extension of the existing 16-inch diameter pump intake lines to the enlarged wet well extension. Following coring, all final mechanical hook ups were performed. Wet well extension construction was completed on or about April 20, 1989. Temporary sheet pile shoring was left in place and LCGC's dewatering system was removed following completion of the wet well. Details for the Black Ditch wet well construction are presented on Plan 11 of the Record Drawing Set.

6.4.2 Concrete Process and Stormwater Pipe and Black Ditch Closure

In conjunction with the Black Ditch pumphouse wet well construction activities, a precast 48-inch diameter IDOT Class III concrete process and stormwater sewer was installed to connect the wet well extension to an existing 48-inch diameter process and stormwater sewer on the western end of the Black Ditch waterway.

Following excavation of the sludge from the Black Ditch waterway the excavation was backfilled with sand from the Borrow Pit. LCGC installed the concrete sewer pipe with support of a trench-box to support the trench side slopes. The sewer installation was backfilled with sand.

At the western end of the concrete sewer pipe, connection was made to an existing clay tile process and stormwater sewer line with a concrete manhole/catch basin, cast in place by SCC. The cast in place concrete manhole/catch basin utilized an existing sewer pipe head wall for one of its sides, as approved by USEPA, while the remaining three sides and roof were steel reinforced and poured. Installation of a pre-cast catch basin, as originally specified in Attachment B of the Amended Work Plan, at this location would have required removal of the head wall which would have potentially jeopardized the integrity of the clay tile sewer pipe.

A pre-cast concrete drop inlet was installed near the eastern end of the concrete sewer pipe as specified in Attachment B of the Amended Work Plan. Details for the Black Ditch process water and stormwater sewer installation are shown on Plan 10 of the Record Drawing Set.

6.5 PUMPHOUSE EFFLUENT PIPING & ENERGY DISSIPATORS

The existing energy absorbing inlet structure (dissipator) located at the south end of the Catch Basin was to be replaced by a newly constructed energy dissipator as shown on Plan 10 of the Record Drawing Set. LCGC constructed and installed the energy dissipator in late April 1989 in accordance with Attachment B of the Amended Work Plan.

On September 28 and 29, 1989, following completion of the sheet pile wall construction and prior to demobilization, Falcon Marine Company (Falcon) of Waukegan, Illinois replaced two existing 18-inch diameter Transite® effluent forcemain lines located between the Black Ditch pumphouse and Catch Basin, with two 18-inch diameter ductile iron pipes of lengths 83 feet and 62 feet, respectively as shown on Plan 10. The removed Transite® piping was set at the base of slope north of the Black Ditch and covered with sand. The new cast iron forcemain pipes were oriented to discharge directly into the new energy dissipator in accordance with Attachment B of the Amended Work Plan.

LCGC assisted Falcon in replacing the forcemain piping by excavating for the two Transite® pipes through the former roadway at the south end of the Catch Basin. Excavation into the existing materials/soils was performed in Level C personnel protective equipment in accordance with the project Health and Safety Plan (see Section 8.2). Following removal of the existing Transite® pipes, the excavation was lined with a minimum of six inches of sand from the Borrow Pit. Following forcemain installation, LCGC backfilled the excavation and forcemain with sand from the Borrow Pit.

Remedial soil cover was subsequently constructed over the forcemain piping as discussed in other sections of this report.

In addition to the energy dissipator built for the influent to the Catch Basin, a field decision was made to utilize an out of service dump truck bed for an energy dissipator at the point of discharge from Mixing Basin Stage 5 to the Settling Basin as shown on Plan 7 of the Record Drawing Set. Attachment B of the Amended Work Plan specified placement of riprap stone only at the discharge point. Manville and USEPA representatives agreed that placement of the dump truck bed backfilled with riprap stone at the point of discharge from Mixing Basin Stage 5 would provide better erosion protection for the adjacent sloped areas. Placement of the energy dissipator was completed in April 1989. Details of the energy box installation are shown on Plan 14 of the Record Drawing Set.

6.6 POWER POLE AND POWERLINE RELOCATION

To facilitate construction of the remedial soil cover on the northern sloped area of the Black Ditch existing power poles and lines leading from the Plant to the Black Ditch pumphouse required relocation. From June 14 to June 19, 1989, Benson Electric (Benson) of Waukegan, Illinois installed nine new power poles, approximately 30 feet south of the existing power poles, as directed by the OSR and Schuller's Plant Manager.

Materials/soils excavated to install the new power poles were placed in double 6-mil polyethylene asbestos disposal bags. The bags were voided of air spaces and sealed with duct tape. All bagged waste materials/soils from the power pole installations were disposed of in the Asbestos Disposal Pit prior to its closure on June 30, 1989.

The Plant salvaged the former electrical wiring. The four existing power poles along the base of the Black Ditch north slope were pushed over by backhoe and left at the base of the northern sloped area for subsequent backfill and grading with sand and construction of the remedial soil cover.

6.7 CONCRETE SPILLWAY

A nominal 36-inch wide concrete spillway structure was to be constructed through the northern dike of the Settling Basin near the northeast corner to facilitate return of Plant process water to the Industrial Canal and to control the maximum elevation of water within the Settling Basin.

On June 15, 1989, SCC mobilized to construct the concrete spillway. Construction of the concrete spillway involved excavating a trench through the north dike of the settling basin. LCGC performed all excavation activities. All work by both LCGC and SCC on the concrete spillway was performed in Level C personnel protection equipment as described in Section 8.2 until the potential for exposure to ACM was eliminated by lining the work area with a minimum six-inch thick sand layer. The concrete spillway, completed by July 8, 1989, was constructed as shown on Plan 12 of the Record Drawing Set.

One set of concrete test cylinders were prepared by O'Brien field inspectors to verify that a concrete compressive strength of at least 4,000 pounds per square inch (psi) was achieved. The concrete test results as reported by O'Brien are presented in Appendix D.

6.8 COLLECTION BASIN LEVEL CONTROL DRAINS

The direction of water flow from the active wastewater treatment system prior to remedial construction was from the Black Ditch pumphouse to the Catch Basin to the Mixing Basins and Settling Basin. From the Settling Basin water discharged into the Collection Basin, Southeast Ditch and East Ditch. From the East Ditch, waters ultimately flowed into the Industrial Canal through a former ditch and culvert pipe. Following closure of the East Ditch by the Manville Plant and subsequent construction of the remedial soil cover, seepage from the Settling Basin began to increase the level of water within the Collection Basin. On July 11, 1989, a small overflow occurred on the South Bank of the Collection Basin. Overflow waters began to drain to the former Seepage Basin located east of the East road. A clay berm was constructed along the Collection Basin south bank to stop the overflow. The OSR directed LCGC to pump water from the Collection Basin directly into the Industrial Canal to lower the water level. LCGC mobilized one six-inch and one eight-inch diesel pump to accomplish this task.

On June 16, 1989, Schuller submitted plans to USEPA for construction of a level control drain at the northern end of the Collection Basin to permanently control the water level and prevent future overflows. On July 28, 1989, USEPA granted approval to construct the level control drain. On August 1, 1989 LCGC excavated to expose two existing 30-diameter storm lines as shown on Plan 10. To provide adequate service for the proposed Collection Basin level control drains, LCGC extended the existing storm lines using two 18-inch diameter corrugated plastic culvert pipes to connect with two of several existing 30-inch diameter Transite® culverts flowing under the North Road to the Industrial Canal as shown on Plan 10 of the Record Drawing Set. New and existing pipelines were backfilled with sand from the Borrow Pit on August 22, 1989.

Concurrently, LCGC excavated and installed three 10-inch diameter PVC pipelines as shown on Plan 10 of the Record Drawing Set, at the north end of the Collection Basin and connected them to three of the six 10-inch diameter perforated PVC seepage drain lines installed previously by LCGC at the north end of the East Ditch to alleviate subsurface hydraulic pressures following the East Ditch closure as discussed in Section 4.4.17. The 10-inch diameter PVC drainlines extended into the Collection Basin and ended with a 90° elbow facing in the upward direction. Following installation of the drainlines, the excavation was backfilled with sand from the Borrow Pit. Excavated materials were verified to contain ACM and were placed along the North bank of the Collection Basin and later covered by remedial soil cover. The location and details for the Collection Basin level control drains are presented on Plan 10 of the Record Drawing Set. Level control drain construction was completed by late August 1989.

Shortly after the overflow of water from the Collection Basin on July 11, 1989 as discussed above, the OSR directed CCJM to collect representative samples of the overflowing water at the point of entry into the Seepage Basin. Water samples collected were analyzed for asbestos to confirm whether or not the overflowing water contained asbestos fiber concentrations in exceedance of the action level of 7.1 MFL (fibers greater than 10 µm in length) specified in "Attachment C, Quality Assurance Project Plan" (QAPP), as presented in Appendix O. The analytical data results for the water samples collected are further discussed in Section 11.3 and are presented in Appendix M.

6.9 CONCRETE STABILIZATION BLOCKS

A review of the remedial soil cover design for the southern bank of the Settling Basin by Schuller indicated that there was potential for slope soil cover failure based on the grade and length of the slope on the southern bank and the foundation materials (sediments) at the toe of slope in the Settling Basin. To minimize the potential for slope failure the OSR directed LCGC to position precast 4-foot by 4-foot by 3-foot concrete blocks on the floor of the Settling Basin along the toe of the slope to provide a buttress for the slope soil cover. A test section of concrete blocks and sand cover was constructed along the Settling Basin south slope on August 24, 1989. Following approval of the test section by USEPA, the balance of the concrete blocks and remedial cover were installed.

LCGC completed placement of the concrete stabilization blocks by August 31, 1989. Details for the Settling Basin south slope construction are presented on Plan 9 of the Record Drawing Set.

6.10 SHEETPILE SLOPE RETAINMENT WALL

A six-inch thick riprap cover was proposed to be constructed on a slope of 1:1 along the enbankment north of the Black Ditch pumphouse and the riprap held in place by cement grouting. Upon review of this design by Schuller, several difficulties related to long term maintenance and constructibility were identified. After investigating several alternatives, installation of a sheetpile wall to retain the steep slope was chosen. On September 12, 1989, Falcon mobilized pile driving equipment and materials to begin installation of a sheetpile wall north of the Black Ditch pumphouse as shown on Plan 10 of the Record Drawing Set. Each sheetpile was anchored a minimum of 20 feet into existing ground and 10 feet of sheetpile remained exposed. One waler and six tie-backs were installed subsequent to pile driving and fastened to the sheetpile wall by welding to increase the wall's integrity. Following completion of the sheetpile wall, a 6-inch diameter perforated PVC seepage drain was installed at the base of the northern side of the sheetpile wall to collect seepage from the Catch Basin. Water collected by the drain discharges to the ground surface east of the sheet pile wall. The sheetpile retainment wall installation was completed on September 26, 1989. Seepage drain construction was completed on September 27, 1989.

Following Falcon's demobilization on September 29, 1989, LCGC backfilled the space between the sheet pile wall and the former northern slope of the Black Ditch with sand from the Borrow Pit and graded the sand to a 2:1 slope. A 24-inch thick remedial soil cover was subsequently constructed over the sand backfill. Details for the sheet pile wall and remedial soil cover construction are presented on Plan 10.

6.11 WEST PERIMETER DRAINAGE DITCH

In accordance with the Second Work Plan Supplement, a vegetated clay/topsoil berm was constructed along the western perimeter of the disposal area (West Perimeter Ditch) over existing asphalt pavement as shown on Plan 5 of the Record Drawing Set. In addition, a berm was constructed along the west perimeter of the South Central Area - West. Both berms were constructed to direct surface stormwater runoff from the remedial soil cover to the Industrial Canal or Black Ditch. From May 7 to May 14, 1990 LCGC constructed the clay berms as detailed on Plan 8 of the Record Drawing Set. A three-inch thick topsoil cover was placed on the berms from May 14 to May 23, 1990. The invert of the berms was either lined with sod supplied by Thorton Sod Farm of McHenry, Illinois or seeded in accordance with Attachment B during the period May 23 to May 29, 1990. The outer slope of each berm then was fertilized and seeded. All West Perimeter Drainage Ditch construction was completed by May 29, 1990.

6.12 SEMI-TRAILER DOLLY SUPPORTS

In accordance with the Second Work Plan Supplement, the area west of the Pumping Lagoon (Semi-trailer Staging Area) as identified on Plan 2 of the Record Drawing Set, was remediated by construction of a 12-inch thick compacted granular cover. As part of the remedial construction in this area, the Second Work Plan Supplement specified construction of 48-inch wide by 10-inch thick reinforced concrete slabs to support Semi-trailers as shown on Plan 4 of the Record Drawing Set. These support slabs (semi-trailer dolly supports) were constructed to replace existing dolly supports in the Semi-trailer Staging Area.

LCGC subcontracted Falduto Construction Company (Falduto) of Waukegan, Illinois to construct the concrete dolly supports. Falduto mobilized equipment to the Site on September 24, 1990. LCGC prepared a granular sub-base for each slab with sand from the Borrow Pit. Falduto formed and poured the southern most semi-trailer dolly support on September 24, 1990 and the northern most semi-trailer dolly support on September 25, 1990. Each dolly support slab was located immediately south of existing dolly support. Typical details for the dolly support are presented on Plan 8 of the Record Drawing Set. Falduto demobilized from Site on September 26, 1990.

6.13 CULVERTS/DROP INLETS

Installation of several concrete culverts was required to facilitate continued operations of the active wastewater treatment system and to direct surface stormwater runoff from the remedial soil cover. For each culvert installation LCGC personnel worked in Level C personnel protective equipment as described in Section 8.2. All excavations for culvert installations were performed using LCGC's backhoe and water truck. Areas were typically wetted with water prior to and during excavation. ACM excavated during culvert installations was transported to the Asbestos Disposal Pit or Mixing Basin Stage 6 for disposal.

All culverts were installed on a minimum six-inch thick layer of compacted granular material. Following installation of several culvert sections, the trench was backfilled with sand from the Borrow Pit to minimize the length of open trenching. Subsequent to installation and backfill, LCGC constructed remedial soil cover over each culvert.

In accordance with the Second Work Plan Supplement surface stormwater runoff from the area west of the South Central Area - West was to be handled by an existing storm sewer. Three existing drop inlet/catch basins were identified by the OSR and were hydraulically tested by running water from LCGC's water truck through each to assure water would flow through them. Each drop inlet/catch basin then was cleared of sediment and debris. All sediment and debris generated was disposed of in the AMWDP. A 24-inch diameter cast iron grate then was installed on each drop inlet/catch basin and surrounding remedial soil cover constructed. Drop inlets /catch basins utilized are identified on Plan 5 of the Record Drawing Set.

6.14 WARNING SIGNS

Warning signs identifying the Site as an asbestos disposal site were installed by LCGC along the perimeter fence lines and western perimeter of the disposal area as identified on Plans 4, 5 , 6 and 7 of the Record Drawing Set. The 14-inch by 20-inch aluminum signs were worded in accordance with 40 CFR Part M 61.153 (b) (1) (iii) and formatted in accordance with 29 CFR 1910.145 (d) (4). All warning signs were anchored a minimum of 24 inches into firm ground and spaced at no greater than 500 foot centers along the fence. Typical perimeter warning sign details are presented on Plan 14 of the Record Drawing Set.

6.15 RIPRAP SLOPE PROTECTION/SPILLWAYS

During the course of the remedial construction at the Site several areas covered by remedial clayey soil cover were damaged by erosion due to surface stormwater runoff. LCGC repaired most washouts by rebuilding the clay and topsoil cover. However, in areas subject to higher water flow volumes, LCGC placed a minimum 12-inch thick riprap cover over the clay in place of the topsoil cover to prevent future washouts. Supac® 4NP geotextile was installed over the clay cover prior to riprap placement to prevent clay migration through the riprap stone.

Riprap cover was placed in one area along the western slope of the disposal area and one area along the south slope of the Settling Basin. Additional riprap cover was installed at several locations along the

Industrial Canal and Pumping Lagoon as deemed necessary through the course of the project.

All areas of riprap erosion cover described above are identified on Plans 4, 5, 6 and 7 of the Record Drawing Set.

7.0 SURFACE CLEANUP

In accordance with the USEPA approved Second Work Plan Supplement and Third Work Plan Supplement, areas of the Plant Site not addressed in Article V of the Consent Decree and confirmed to contain only surficial ACM were carefully inspected and all ACM identified was collected, bagged and disposed of at an approved off-Site disposal Site.

Under the Second Work Plan Supplement, all surficial ACM in areas west of the Disposal Area and the Borrow Pit perimeter roadway were removed. ACM removal began in early October 1990 and continued through December 1990. Except for the Borrow Pit perimeter roadway, all ACM collected was placed into double 6-mil polyethylene bags designed for asbestos disposal. Each bag was purged of excess air and then sealed with duct tape. Bagged ACM was staged on-Site in a lined and tarped 20 cubic yard roll off container designed for ACM transport, until full. The bagged ACM then was transported to the Browning-Ferris Industries Waste Systems, Inc. (BFI) landfill in Zion, Illinois for disposal. Approximately 30 cubic yards of bagged ACM was transported to and disposed of at the BFI landfill under the Second Work Plan Supplement.

In the Borrow Pit, USEPA approved placement of surficial ACM found in areas adjacent to the Borrow Pit perimeter roadway, on to the perimeter roadway prior to construction of remedial cover. The roadway was found to be constructed of broken Transite® and it was believed that the ACM found adjacent to it was at one time part of the roadway and had been moved by vehicle traffic or heavy equipment during the construction of the roadway.

Following completion of cleanup of surficial ACM from the Borrow Pit roadway adjacent areas, the perimeter roadway was remediated by construction of a 14-feet wide Class II gravel roadway, as described in Section 4.5.

Under the Third Work Plan Supplement, portions of Area Y and Area Z as identified on Plan 2 of the Record Drawing Set, were to be remediated by cleanup of surficial ACM while other portions of Area Y and Area Z were to be remediated by construction of a remedial soil cover. DAC was retained by Schuller, to conduct the surficial ACM cleanup in Area Y and Area Z from June 17, 1991 to July 12, 1991. DAC delineated areas to be surficially cleaned into zones of approximately 400 square feet each and cleaned each zone three times prior to final inspection by the OSR and the USEPA OSC. All collected ACM was placed in double 6-mil polyethylene bags designed for asbestos disposal and the bags voided of air space prior to sealing with duct tape. All bagged ACM was stored in a lined and tarped 20 cubic yard roll-off container, designed for ACM transport, which was transported to and contents disposed of, at the BFI landfill. A total of 18 cubic yards of bagged ACM was collected, transported and disposed of from Area Y and Area Z under the Third Work Plan Supplement.

8.0 HEALTH AND SAFETY

8.1 GENERAL

The purpose of Attachment G, Health and Safety Plan for Remedial Action (HSP) dated June 1988 and prepared by CCJM (Appendix E), was to establish personnel protection/safety protocol, define responsibilities of the different organizations and personnel involved with the Site, establish safe operating procedures relative to physical and chemical conditions encountered on-Site, identify and delineate work zones, establish personnel and equipment decontamination protocol, and provide for contingencies which might arise during the course of remedial construction activities. The focus of the HSP was to minimize the risk of exposure to ACM by Site personnel, Plant personnel, and the general public during the process of remediating the Site.

The HSP specifically addressed the chemical constituents detected in the on-Site soils during the RI, safety procedures and levels of personnel protection, personnel and equipment decontamination procedures, dust control procedures and emergency procedures. In addition to the HSP, detailed procedures for handling potential ACM (dated December 14, 1988) were developed in December, 1988 by Schuller and approved by USEPA to clarify provisions in the HSP. A copy of the supplemental procedures is presented in Appendix F. The following sections further addresses personal protective equipment, personnel air monitoring, decontamination procedures and dust suppression procedures implemented during remedial construction activities at the Site.

8.2 PERSONAL PROTECTIVE EQUIPMENT

During implementation of remedial construction activities at the Site where potential contact or handling of ACM was required, all personnel involved were required to wear Level C personal protective equipment (PPE) including:

- full-face piece, air-purifying respirator (APR) equipped with high efficiency purifying air (HEPA) canister filters (NIOSH approved) or half-face piece APR with HEPA filters and safety glasses;
- Tyvek® disposable coverall;
- latex inner gloves;
- nitrile or cotton outer gloves (dependent on work situation);
- hard hat;
- steel toed work boots; and
- rubber outer boots.

Prior to Site personnel entry on-Site, the contractor's health and safety officer discussed with each worker the hazards associated with the Site and conducted and logged respirator fit tests for each worker.

Following completion of sand cover placement on the Site, the potential for contact with ACM and/or other contaminants was eliminated. Subsequently, PPE requirements were reduced to Level D which included any clothing or equipment appropriate and specific to the work task.

8.3 DECONTAMINATION

During mobilization activities in November 1988, LCGC constructed a personnel and equipment decontamination area near the southwest corner of the Site as located on Plan 2 of the Record Drawing Set. The decontamination area consisted of a personnel shower facility, equipment washdown pad equipped with high pressure steam cleaner, decontamination water holding tank and support office trailers. The decontamination area was segregated from the remediation Site by barrier fencing. In addition, Schuller established standard decontamination protocols for safely entering and exiting the Site as discussed in the HSP.

8.3.1 Personnel Decontamination

All personnel working on-Site in "Level C" PPE, described in Section 8.2, were required to follow a detailed decontamination procedure (decon procedure) prior to exiting the remediation Site as discussed in the HSP and presented in Appendix G and illustrated on Plan 14 of the Record Drawing Set. This procedure included systematic removal and disposal of outer protective clothing and daily hot water showers prior to leaving the Site. Shower waters from the decontamination facility were stored in a 1,000-gallon concrete holding tank pending disposal of decontamination waters in the Asbestos Disposal Pit (before June 30, 1989) or the Settling Basin (after June 30, 1989).

8.3.2 Equipment Decontamination

All equipment and vehicles used on-Site during "Level C" remedial construction activities were required to be thoroughly decontaminated prior to exiting the Site or contaminated work areas. Prior to completion of the Site perimeter roadway cover, all vehicles, heavy equipment and tools were thoroughly cleaned of visible debris at the equipment decontamination wash pad using a high pressure steam cleaner. In work areas where it was not possible to transport or move the equipment to the decontamination wash pad without potentially cross contaminating remediated work areas, the equipment was thoroughly washed of bulk visible debris with pressurized water from LCGC's water truck at the edge of the contaminated work area prior to moving onto the remediated area. The equipment then was moved to the decontamination wash pad for a final high pressure hot water spray rinse. Prior to demobilization of equipment from the Site, equipment was inspected by the OSR to assure that proper decontamination was performed.

All waste waters generated at the decontamination wash pad were stored in the 1,000-gallon concrete holding tank and periodically pumped out, transported to and disposed of in the Asbestos Disposal Pit (before June 30, 1989) or the Settling Basin (after June 30, 1989).

Following completion of all remedial construction activities at the Site and prior to final demobilization, LCGC pumped remaining decontamination water from the concrete holding tank and disposed of waters in the Settling Basin. Subsequently, LCGC backfilled the concrete holding tank with sand from the Borrow Pit.

8.4 PERSONNEL AIR MONITORING

As specified in Appendix G-C of the HSP, LCGC collected personnel "breathing zone" air samples to measure asbestos fiber concentrations in the breathing zone of on-Site personnel during remedial construction activities involving potential handling or contact with ACM as required by 29 CFR 1910.1001. In addition, air samples were collected from prevailing upwind and downwind locations with respect to designated work areas. At the conclusion of a work shift, air monitoring samples were collected and analyzed by Phase Contrast Microscopy (PCM) and results compared with the permissible exposure concentration of 0.2 fibers per cubic centimeter (f/cc) (fibers >5 μm length). The results for all personnel air monitoring samples collected and analyzed by LCGC are presented in Appendix H and summarized in Table 8.1.

In addition to the personnel air monitoring samples described above, LCGC collected periodic air samples from within the on-Site personnel decontamination facility. The analytical data for these samples as reported by LCGC are also presented in Appendix H and included in Table 8.1.

TABLE 8.1

SUMMARY OF PERSONNEL AND DECONTAMINATION
FACILITY AIR MONITORING DATA
FOR LAKE COUNTY GRADING COMPANY
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS -MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Month/Year	*Number of Samples Taken*	*Distribution of Samples with Fiber Concentration Range[1]*			
		0.0-0.099	*0.1-0.199*	*≥0.2*	*Damaged*
11/88	52	49	2	0	1
12/88	40	37	1	0	2
1/89	42	33	0	2	7
2/89	28	28	0	0	0
3/89	69	66	0	0	3
4/89	55	44	0	0	11
5/89	53	46	0	0	7
6/89	27	21	0	0	6
7/91	1	1	0	0	0
8/91	1	1	0	0	0

[1]Fiber concentration (fibers > 5μm length) in fibers per cubic centimeter.

Under the Third Work Plan Supplement, during field activities, LCGC collected and analyzed personnel air monitoring samples during rough grading operations in Area Y and Area Z. The results and summary of these air samples are presented in Appendix H and Table 8.1.

During the course of remedial action at the Site, exceedance of the 0.2 f/cc (fibers >5 μm length) permissible exposure level for on-Site personnel was encountered two times during January, 1989 and at no other time during the course of work at the Site, as shown in Table 8.1.

During the surficial cleanup of ACM from Area Y and Area Z by DAC, RCM was subcontracted by DAC to collect and analyze personnel air monitoring samples as required by 29 CFR 1910.1001. The resulting data, as presented by RCM, for air samples collected are presented in Appendix I and summarized in Table 8.2. As shown on Table 8.2, all fiber concentrations for air samples collected during the surficial cleanup of ACM by DAC were below the 0.2 f/cc permissible exposure level.

Perimeter ambient air monitoring samples were collected by CCJM from project commencement until October 12, 1990 at which time all major "Level C" remedial work (work involving grading and/or covering of ACM waste) was completed. The perimeter air monitoring program is discussed in Section 9.0 of this report. During the Third Work Plan Supplement field activities, no perimeter ambient air monitoring was conducted, as approved by USEPA.

TABLE 8.2

SUMMARY OF PERSONNEL AIR MONITORING DATA
FOR DIVERSIFIED ABATEMENT CONTRACTORS, INC.
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS -MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Month/Year	*Number of Samples Taken*	*Distribution of Samples with Fiber Concentration Range*[1]			
		0.0-0.099	*0.1-0.199*	*≥0.2*	*Damaged*
6/91	12	11	1	0	0
7/91	14	14	0	0	0

[1]Fiber concentration (fibers > 5μm length) in fibers per cubic centimeter.

8.5 DUST SUPPRESSION

As required under the HSP, LCGC maintained at least one water truck or water wagon on-Site during all remedial construction work to apply dust suppressing water spray on work areas and access roads. Water used for dust control was obtained from the Industrial Canal from October 1988 through September 25, 1989. Subsequently, water was obtained from the Borrow Pit water bodies and from a City of Waukegan hydrant located south of the Site. Waters from both the Industrial Canal and the Borrow Pit were collected and tested for asbestos fiber content as discussed in Section 11.3.

In addition to the application of water for dust control, liquid calcium was applied to the on-Site perimeter access roadways in June, 1989 and July 1989 to reduce the need for wetting the roads with water. The application of liquid calcium to the Site roads was determined to be effective only for a few weeks due to the high volume of truck traffic on-Site. Therefore, LCGC continued wetting the roads with water after July, 1989.

9.0 AIR MONITORING PROGRAM

In accordance with the Amended Work Plan, a boundary air monitoring program was developed and implemented at the Site to document air quality at the perimeter of the Site and to assess the need for additional dust suppression measures, if any, to be employed during the remedial construction.

CCJM was retained by Schuller to implement the air monitoring program at the Site. To date, CCJM has completed collection and analysis of air monitoring samples for asbestos fibers prior to and during remedial construction activities at the Site as required by the Amended Work Plan.

The report of CCJM describing the Air Monitoring Program for the Site to date (Air Asbestos Monitoring During Remedial Action, dated July 1991) is presented in Appendix J.

10.0 MISCELLANEOUS ACTIVITIES

10.1 MONITORING WELL CLOSURES

During the Site Remedial Investigation (RI) program in 1984, five groundwater monitoring wells were installed at locations along the perimeter of the disposal area. During the remedial construction activities at the Site in 1989, it was decided that two of the five RI monitoring wells would no longer be needed and could be abandoned. The casings of the remaining three monitoring wells were to be extended to meet the final grade of the remedial soil cover and were to be utilized for water level monitoring during the Groundwater Monitoring Program.

CRA retained Fox to abandon the two RI wells and to extend the well casings on the remaining three RI wells. On September 20, 1989 Fox mobilized on-Site and abandoned RI monitoring Wells 1 and 5 in accordance with the Illinois Department of Public Health, Illinois Water Well Construction Code. Each of the monitoring wells and protective casings were pulled from the ground utilizing a truck mounted drill rig. The well annulus then was backfilled with slurry concrete to surface grade.

Two of the three remaining RI wells (2, 3 and 4 - now called MW-Z, MW-Y and MW-X, respectively) MW-X and MW-Y had casings extended to meet the final grade of the remedial soil cover. As specified in the Second Work Plan Supplement, monitoring well extensions were typically completed by removing and replacing the existing monitoring well protective casing with a longer casing and connecting a precut well riser extension to the existing well riser by screwing it into existing threads. MW-X was extended on September 20, 1989 while the casings for MW-Y was extended on September 14, 1990 prior to construction of the remedial soil cover on the East Border Area. MW-Z was located east of the remedial soil cover, therefore no well casing extension was required.

10.2 RADIATION MONITORING

During the course of remedial construction at the Site, O'Brien was retained to conduct field density (compaction) tests on the clay and gravel covers to verify compliance with project specifications. In performing these tests O'Brien utilized a nuclear density gauge to measure the relative soil density. O'Brien field inspectors who utilized the nuclear density gauge were required by the Nuclear Regulatory Commission (NRC) to carry a personal radiation dosimeter (radiation badge) to measure their exposure to radiation.

In February 1990, the O'Brien field inspector reported to the OSR that his radiation badge had recorded excessive radiation exposure for the months of August, September and October 1989 and that O'Brien was investigating to determine the source of the radiation.

On March 1, 1990, the OSR, USEPA OSC and a CCJM representative conducted a survey of the Site for radiation. The survey consisted of walking the Site and continuously measuring radiation levels using a Geiger counter with an extended probe (mini Conrad - II Radiation Contamination Monitor, Model 3034-2), held three to six inches above the soil cover. The intent of the survey was to determine if Site materials were potential sources of radiation. The radiation survey concluded that no radiation emissions from the Site or Site soil cover were above normal background levels (<100 counts per minute) and that the Site was not the cause of the O'Brien's field inspector's radiation exposure.

O'Brien subsequently determined that the source for their inspector's radiation exposure was the nuclear density gauge used in measuring the soil compaction. Appendix K presents O'Brien's letter and report submitted to the Illinois Department of Nuclear Safety regarding the events.

11.0 MISCELLANEOUS SAMPLES

11.1 GENERAL

During the course of remedial construction at the Site several miscellaneous liquid and solid samples were collected and analyzed in accordance with the USEPA approved Quality Assurance Project Plan (QAPP) dated June 1988 and prepared by CCJM, for various constituents and purposes. The following sections discuss the miscellaneous sampling at the Site.

11.2 ACTIVE WASTE DISPOSAL AREAS

In accordance with the Consent Decree and Amended Work Plan, miscellaneous samples were collected from the AMWDP, Sludge Disposal Pit and active wastewater treatment system effluent to verify whether or not ACM was present in these areas. Bulk samples of existing material were collected from the AMWDP and Sludge Disposal Pit by CCJM on October 24 and October 25, 1988 and analyzed for bulk asbestos. A liquid sample was collected from the active waste water treatment system effluent in October 1988 by CCJM and analyzed for asbestos. On February 24, 1989, CCJM collected a bulk sample from a portion of the Northeast Corner Area for bulk asbestos analysis. A discussion of the sampling procedures and results of the samples collected by CCJM are presented in CCJM's Miscellaneous Soil and Process Wastewater Monitoring During Remedial Action, dated October 1991 and prepared by CCJM in Appendix L.

The miscellaneous samples collected by CCJM in the AMWDP and Sludge Disposal Pit confirmed the presence of ACM. This resulted in the remediation of these areas as discussed in Sections 4.4.11 and 4.4.15, respectively.

The analytical data for the water sample collected from the active wastewater treatment system effluent confirmed that no asbestos was present in Manville's current process waste stream. No further action was required with respect to the effluent from the active wastewater treatment system.

The analytical data for the bulk sample collected from portions of the Northeast Corner Area confirmed the presence of ACM. The Northeast Corner Area was remediated by placement of a remedial soil cover as discussed in Section 4.4.18.

11.3 WATER SAMPLES

Table 11.1 presents a summary for all miscellaneous water samples collected by CRA and/or CCJM, not specified under the Consent Decree or QAPP, but deemed necessary with respect to the remedial construction activities at the Site. The following summarizes the miscellaneous water samples collected.

TABLE 11.1

SUMMARY OF MISCELLANEOUS LIQUID SAMPLES
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Sample Number	*Date*	*Description*	*Location*	*Asbestos Fiber Concentration (MFL)(1)*	*Reporting Laboratory*
MRA-SWRO-03A	06/15/89	Overflow from Collection Basin	East of Southeast Ditch	0	EMS
MRA-SW1C-01	08/16/89	Surface water	Industrial Canal Pump	2.4	EMS
MRA-SW1C-02	08/16/89	Duplicate of MRA-SW1C-01	Industrial Canal Pump	0	EMS
L2980-090589-SJ-013	09/05/89	Surface water	East Borrow Pit Pond	0.3	Particle Data
L2980-090689-SJ-014	09/06/89	Surface water	West Borrow Pit Pond	<0.1	Particle Data
L2980-090689-SJ-015	09/06/89	Surface water	Industrial Canal Pump	0.4	Particle Data
L2980-091289-SJ-016	09/12/89	Surface water	Industrial Canal Pump	1.2	Particle Data
L2980-091289-SJ-016	09/12/89	Split of above	Industrial Canal Pump	6.9	EMS

Note:
(1)For Fibers >10μm in length
MFL = Million Fibers/Liter

On June 15, 1989 CCJM was directed by the OSR to collect sample number MRA-SWRO-03A, from overflowing waters from the Collection Basin as discussed in Section 6.8. Analysis of this sample did not detect the presence of asbestos fibers greater than 10 μm in length.

On August 16, 1989 CCJM was directed by the OSR to collect samples from LCGC's water supply pump in the Industrial Canal. USEPA had approved the use of waters from the Industrial Canal for Site dust control during the Site remedial construction activities. Analytical data for the two water samples (duplicate) collected by CCJM (MRA-SWIC-01 and MRA-SWIC-02) indicated asbestos fiber concentrations of 2.4 MFL (fibers greater than 10 μm in length) and none detect, respectively. Due to the variance in the analytical results, CRA collected two additional samples from the Industrial Canal pipe on September 6 and September 12, 1989, and CCJM obtained a split sample of the water sample collected on September 12, 1989. The resulting data from these samples again indicated a variation in asbestos fiber concentrations (0.4 MFL to 6.9 MFL fibers greater than 10 μm in length), however all samples, including the two initial samples collected by CCJM, verified that asbestos fiber concentrations were below the surface water exceedance criteria (7.1 MFL fibers greater than 10 μm in length) for asbestos fibers as stated in the QAPP.

In addition, on September 5 and 6, 1989, CRA collected samples from the water in the Borrow Pit east and west ponds. The analytical results for these samples indicated asbestos fibers present at a maximum concentration of 0.3 MFL (fibers greater than 10 μm in length) in the Borrow Pit east pond and less than 0.1 MFL (fibers greater than 10 μm in length) in the Borrow Pit west pond as shown in Table 11.1. Based on the wide variation of the sample results for the Industrial Canal water samples as discussed above, and low asbestos concentrations in the Borrow Pit waters, LCGC was directed by the OSR to relocate their pumping system to the Borrow Pit west ponds and to discontinue use of the Industrial Canal waters for dust control. LCGC relocated the pumping system on September 25, 1989. Prior to placement of the pump into the Borrow Pit west ponds, the pump was decontaminated at the equipment decontamination area following the equipment decontamination procedure discussed in Section 8.3.2.

The analytical data for the miscellaneous liquid samples collected are presented in Appendix M.

11.4 BULK AND SOIL SAMPLES

Table 11.2 summarizes the analytical data for all miscellaneous bulk and soil samples collected at the Site during remedial construction activities. Samples dated August 11, 1989 and August 22, 1989, were collected by CRA from remediated areas of the Site that were tracked by heavy construction equipment from adjacent non-remediated areas. A total of 12 clay samples were collected to verify whether or not ACM was transferred on to the remedial soil cover by tracking. Analysis of all clay samples collected indicated asbestos fibers present at less than one percent by weight by the reporting laboratory (Particle Data Laboratories (Particle Data) of Elmhurst, Illinois). Although no ACM greater than one percent was found in the 12 soil samples, the OSR directed LCGC to remove and replace the top six

TABLE 11.2

SUMMARY OF MISCELLANEOUS BULK AND SOIL SAMPLES
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Date	*Sample No.*	*Type*	*Description*	*Location*	*Asbestos Fiber Concentration(1)*	*Lab*
8/11/89	S-2980-081189-SJ-001	Soil	Clay from surface (0 - 6")	East of Former Catch Basin	<1%	Particle Data
8/11/89	S-2980-081189-SJ-002	Soil	Clay from surface (0 - 6")	East of Former Catch Basin	<1%	Particle Data
8/11/89	S-2980-081189-SJ-003	Soil	Clay from surface (0 - 6")	East of Former Catch Basin	<1%	Particle Data
8/11/89	S-2980-081189-SJ-004	Soil	Clay from surface (0 - 6")	North of Former Drainage Basin	<1%	Particle Data
8/11/89	S-2980-081189-SJ-005	Soil	Clay from surface (0 - 6")	Northwest of Former Drainage Basin	<1%	Particle Data
8/11/89	S-2980-081189-SJ-006	Soil	Clay from surface (0 - 6")	Top of Slope - West of Drainage Basin	<1%	Particle Data
8/11/89	S-2980-081189-SJ-007	Soil	Clay from surface (0 - 6")	Top of Slope - West of Drainage Basin	<1%	Particle Data
8/11/89	S-2980-081189-SJ-008	Soil	Clay from surface (0 - 6")	West of Slope Area	<1%	Particle Data
8/22/89	S-2980-082289-SJ-009	Soil	Clay from depth (14")	North of Drainage Basin	<1%	Particle Data
8/22/89	S-2980-082289-SJ-010	Soil	Clay from depth (0 - 6")	Northwest of Drainage Basin	<1%	Particle Data
8/22/89	S-2980-082289-SJ-011	Soil	Clay from depth (0 - 6")	West of Former Catch Basin	<1%	Particle Data
8/22/89	S-2980-082289-SJ-012	Soil	Clay from depth (0 - 6")	Southwest of Former Catch Basin	<1%	Particle Data
2/07/90	S-2980-020790-SJ-017	Bulk	AC Pipe, Tar Paper, White Powder	20' East of East Road and 40' South of MW-9	8%	EMS Labs
2/07/90	S-2980-020790-SJ-018	Bulk	White Powder, Sludge	West of ME-7A (East Rd.)	<<1%	EMS Labs
2/07/90	S-2980-020790-SJ-019	Bulk	A.C. Pipe, Tar Paper	10' West of East Road 150' S of MW-5 (East Rd.)	13%	EMS Labs
2/07/90	S-2980-020790-SJ-020	Bulk	White Powder, AC Pipe, Shingle Tab	30' North of ME-5 (East Rd.)	24.60%	EMS Labs
2/07/90	S-2980-020790-SJ-021	Bulk	AC Pipe, White Powder, Sludge	50' West of Conc. Spillway (South Bank of Ind. Canal)	9.78%	EMS Labs
2/07/90	S-2980-020790-SJ-022	Bulk	AC Pipe, Tar Paper, Misc.	West Bank of Industrial Canal	17.30%	EMS Labs
2/07/90	S-2980-020790-SJ-023	Bulk	White/Gray Cotton Like Powder	Southeast Corner of Pumping Lagoon	18.50%	EMS Labs
2/07/90	S-2980-020790-SJ-024	Bulk	AC Pipe, Tar Paper	30' East of Pump House (S. Bank of Pumping Lagoon)	20%	EMS Labs
2/07/90	S-2980-020790-SJ-025	Bulk	AC Pipe, Red Board	West Bank of Pumping Lagoon	10.70%	EMS Labs
2/07/90	S-2980-020790-SJ-026	Bulk	AC Pipe, Tar Paper	Semi-Trailer Staging Area	5%	EMS Labs
2/07/90	S-2980-020790-SJ-027	Bulk	White/Gray Cotton Like Powder	S. Bank of Borrow Pit Pond and Semi-Trailer Staging Area	5.36%	EMS Labs
2/07/90	S-2980-020790-SJ-028	Bulk	AC Pipe	Near MW-1 and MW-2	12%	EMS Labs

Note:

1. <<1% = 0.5% (Lab Designation)

TABLE 11.2

SUMMARY OF MISCELLANEOUS BULK AND SOIL SAMPLES
REMEDIAL CONSTRUCTION WORK
FORMER JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Date	*Sample No.*	*Type*	*Description*	*Location*	*Asbestos Fiber Concentration(1)*	*Lab*
2/07/90	S-2980-020790-SJ-029	Bulk	Yellow Cloth, Gravel, Gray Board	Subgrade of West Parking Lot	9.42%	EMS Labs
2/08/90	S-2980-020890-SJ-030	Soil	Brown Sandy Clay	South Road 30' West of Southeast Corner	<<1%	EMS Labs
2/08/90	S-2980-020890-SJ-031	Soil	Brown Sandy Clay	South Road 100' East of MW-12	<1%	EMS Labs
2/08/90	S-2980-020890-SJ-032	Soil	Brown Clay	South Road 200'West of RR Block	<1%	EMS Labs
2/08/90	S-2980-020890-SJ-033	Soil	Brown Sand and Clay	South Road 100' West of RR Switch	<1%	EMS Labs
2/14/91	S-2980-020890-SJ-034	Bulk	Gray Misc. Material	Between Tracks North of Plant Building	1 - 3%	Particle Data
2/14/91	S-2980-020890-SJ-035	Bulk	Yellow-Brown Sludge Like Material	Between Tracks North of Plant Building	1 - 3%	Particle Data
2/14/91	S-2980-020890-SJ-036	Bulk	White Granular Material	West of Overhead Pipe North of Plant Building	<1%	Particle Data
2/20/91	S-2980-022091-SJ-037	Bulk	Gray Misc. Material	Between Tracks North of Plant Building	1 - 3%	Particle Data
2/20/91	S-2980-022091-SJ-038	Bulk	Yellow-Brown Sludge Like Material	Between Tracks North of Plant Building	1 - 3%	Particle Data
2/20/91	S-2980-022091-SJ-039	Bulk	White Granular Material with Transite	West of Overhead Pipe North of Plant Building	3 - 5%	Particle Data
2/21/91	S-2980-022191-SJ-040	Bulk	White Granular Material with Misc. Soil	West of Overhead Pipe North of Plant Building	3 - 5%	Particle Data
5/28/91	S-2980-052891-SJ-041	Soil	Dark Brown Silty Sand	Decon Area Holding Tank Sediment	5 - 10%	Particle Data

Note:

1. <<1% = 0.5% (Lab Designation)

inches of clay cover from areas tracked by heavy equipment as agreed to with USEPA. Removed clayey soil was spread over adjacent non-remediated areas which were subsequently covered by remedial soil cover.

Samples collected on February 7, 1990 (S-2980-020790-SJ-017 through S-2980-020790-029) represent split samples of USEPA's and IEPA's samples collected to verify the presence of ACM in areas not addressed under the Consent Decree or Amended Work Plan. These samples verified that ACM was present and resulted in the development and submittal of Second Work Plan Supplement to USEPA by Schuller. As shown in Table 11.2 all samples but one collected on February 7, 1990 contained asbestos fiber concentrations in excess of one percent.

Four soil samples were collected on February 8, 1990 by CRA from existing soils along the southern Site perimeter roadway. Neither USEPA nor IEPA representatives were present during the collection of these soil samples. These samples were collected to determine whether or not ACM was present. Analysis of the four samples indicated that asbestos fiber concentrations were all less than one percent.

Samples dated February 14, 1991 and February 20, 1991 were collected from Area Z by CRA to verify whether or not ACM was present. As shown in Table 11.2 the asbestos fiber concentrations for all samples except one collected in Area Z ranged from one percent to five percent. As a result, the Third Work Plan Supplement was developed and submitted to USEPA by Schuller to address the remediation of Area Z as summarized in this report.

Sample S2890-052891-SJ-041 was collected by CRA from the sediment contained in the decontamination area holding tank in May of 1991. The disposition of the decontamination area holding tank sediment was not addressed in the Amended Work Plan, Attachment B or HSP. Since the sediment contained from five to ten percent asbestos by weight and the Plant had no future need for the holding tank following completion of the remedial construction work, the sediment was left in the holding tank and the holding tank closed and filled with sand from the Borrow Pit as discussed in Section 8.3.2.

The analytical data results for all miscellaneous bulk and soil samples collected are presented in Appendix N.

12.0 CONCLUSIONS

As of August 21, 1991 all remedial construction activities at the former Johns-Manville Disposal Area were completed. All remedial work was completed by the completion dates specified.

The final draft of the Operations and Maintenance (O & M) program, designed to ensure the integrity of the various remedial covers overlying areas of the Site was submitted to USEPA and IEPA on November 15, 1991. USEPA and IEPA approval of the O & M was granted on December 11, 1991. Schuller has commenced implementation of the USEPA approved O & M program.

In addition to the O & M program, post construction monitoring programs include groundwater, air and soil sampling, as well as bi-annual visual soil cover monitoring events. These programs are further discussed in the QAPP.

APPENDIX A

H. H. HOLMES SOIL TEST DATA

APPENDIX A-1

SAND

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Report No. 1

November 21, 1988

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

REPORT OF TESTS

Subject : Analysis of Fine Aggregate
Material : Fine Sand with some Gravel
Date Received : 11-16-88
Method of Tests : ASTM C-40, D-698, G-51, C-136, D-422

TEST DATA

Sample No.	1	2	3
Asbestos	Not detected	Not detected	Not detected
pH	6.8	6.8	6.8
Organic	None*	None*	None*
Moisture (%)	8.2	7.8	7.9
Standard Proctor (lbs/ft^3)	104.9	106.8	105.8
Optimum Moisture	9.5	9.4	9.5
% Sand	94	96	95
% Silt	6	4	5
% Clay	0	0	0

*Note: Samples contain some roots which were removed before testing, but no other organic material was found.

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

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Report No. 2

November 21, 1988

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

REPORT OF TESTS

Subject : Analysis of Fine Aggregate
Material : Fine Sand with some Gravel
Date Received : 11-16-88
Method of Tests : ASTM C-136

TEST DATA

Sieve Size	%Passing		
Sample No.	1	2	3
1 1/2"	100.0	100.0	100.0
1"	100.0	93.0	100.0
3/4"	100.0	92.0	96.0
1/2"	96.0	91.0	95.0
3/8"	95.0	90.0	94.0
No. 4	91.0	87.0	90.0
No. 8	89.0	83.0	86.0
No. 16	84.0	79.0	80.0
No. 30	78.0	74.0	74.0
No. 50	56.0	50.0	48.0
No. 100	4.0	3.0	4.0
No. 200	1.0	0.0	1.0

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

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Report No. 3

November 21, 1988

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

Gentlemen:

Attached is a graph showing the results of the Modified Proctor Test which we made on a sample of Fine Sand with some Gravel which we sampled from the above noted project.

The test results indicate a Maximum Compaction or Optimum Density of 104.9 pounds per cubic foot with a water content of 9.5%.

The sample had a field moisture of 8.2%.

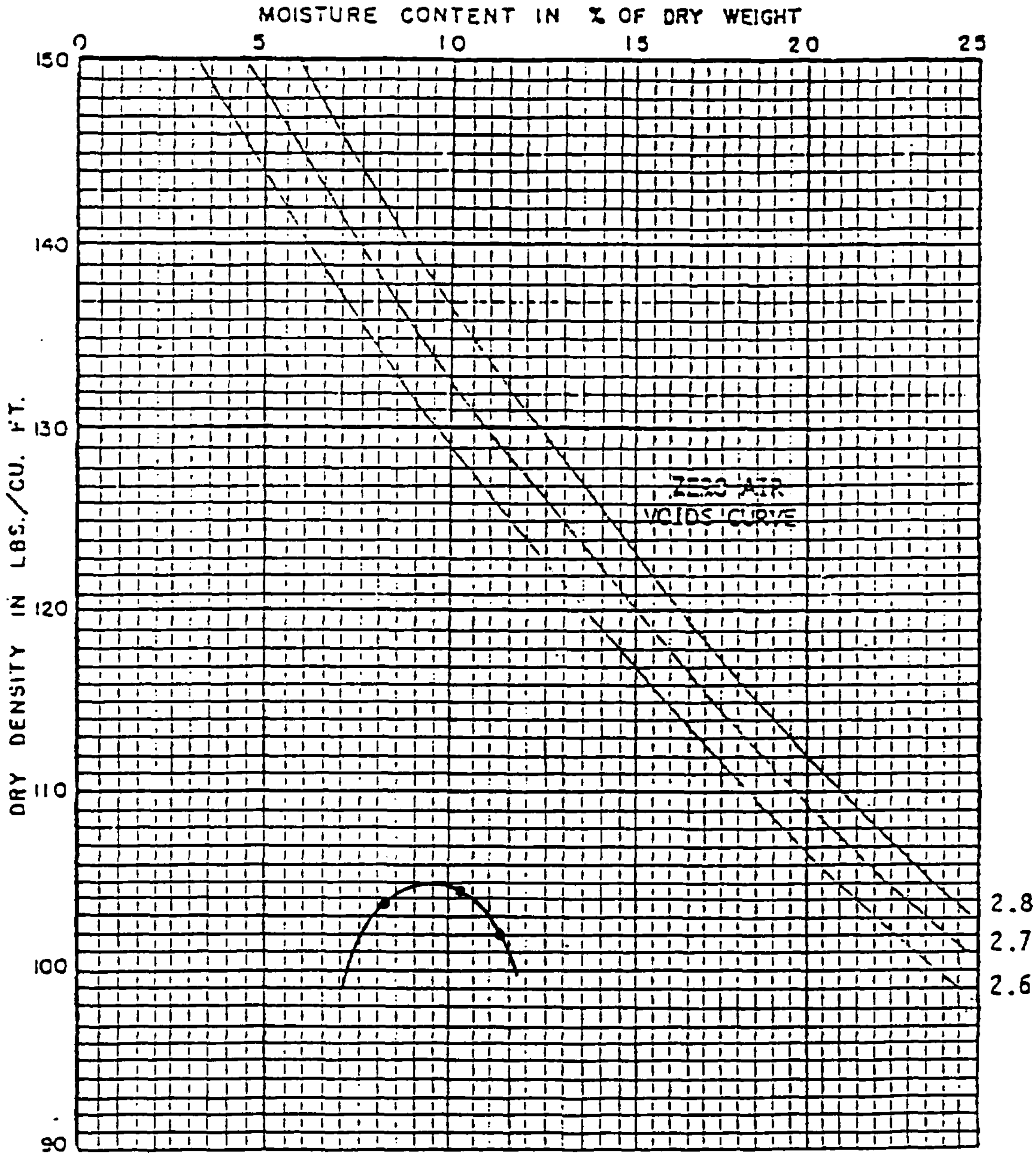
Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

SOIL Fine Sand with some Gravel
LOCATION John Manville
OPTIMUM MOISTURE CONTENT 9.4%
MAXIMUM DRY DENSITY 106.8#
METHOD OF COMPACTION ASTM D-1557



COMPACTION TEST DATA

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Report No. 4

November 21, 1988

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

Gentlemen:

Attached is a graph showing the results of the Modified Proctor Test which we made on a sample of Fine Sand with some Gravel which we sampled from the above noted project.

The test results indicate a Maximum Compaction or Optimum Density of 106.8 pounds per cubic foot with a water content of 9.4%.

The sample had a field moisture of 7.8%.

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

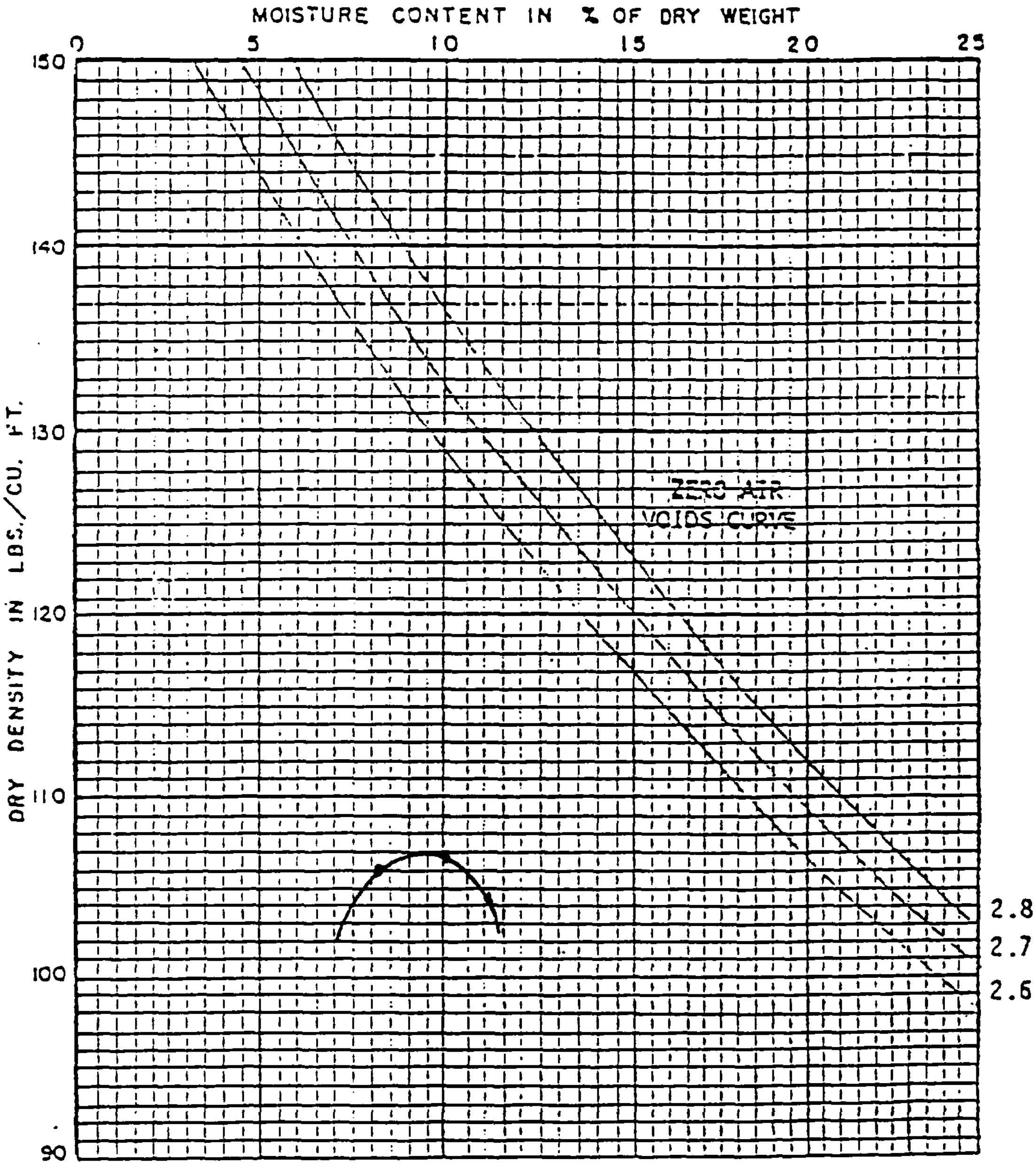
SOIL Fine Sand with some Gravel

LOCATION John Mansville

OPTIMUM MOISTURE CONTENT 9.4%

MAXIMUM DRY DENSITY 106.8#

METHOD OF COMPACTION ASTM D-1557



COMPACTION TEST DATA

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Report No. 5

November 21, 1988

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

Gentlemen:

Attached is a graph showing the results of the Modified Proctor Test which we made on a sample of Fine Sand with some Gravel which we sampled from the above noted project.

The test results indicate a Maximum Compaction or Optimum Density of 105.8 pounds per cubic foot with a water content of 9.5%.

The sample had a field moisture of 7.9%.

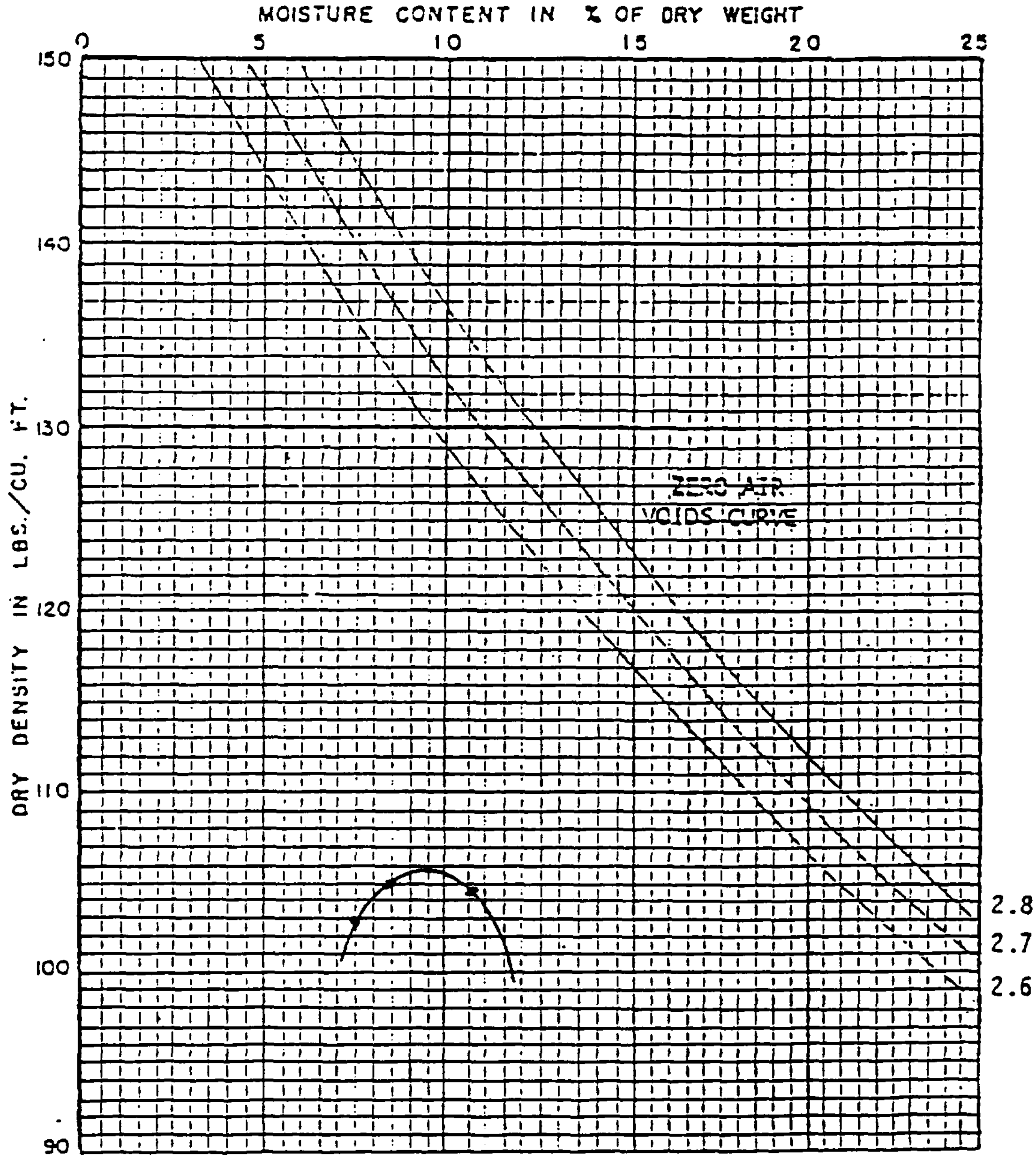
Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

SOIL Fine Sand with some Gravel
LOCATION John Mansville
OPTIMUM MOISTURE CONTENT 9.5%
MAXIMUM DRY DENSITY 105.8#
METHOD OF COMPACTION ASTM D-1557



COMPACTION TEST DATA

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Report No. 1

January 6, 1989

Lab No. CH 4447
File No. 6890.1

Mansville Corporation
P.O.Box 228
Waukegan, IL 60087

Re: John Mansville
Waukegan,IL

Gentlemen:

Attached is a graph showing the results of the Modified Proctor Test which we made on a sample of Fine Sand with some Gravel which we sampled from the above noted project.

The test results indicate a Maximum Compaction or Optimum Density of 105.7 pounds per cubic foot with a water content of 9.3%.

The sample had a field moisture of 0.8%.

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

Mansville Corporatior

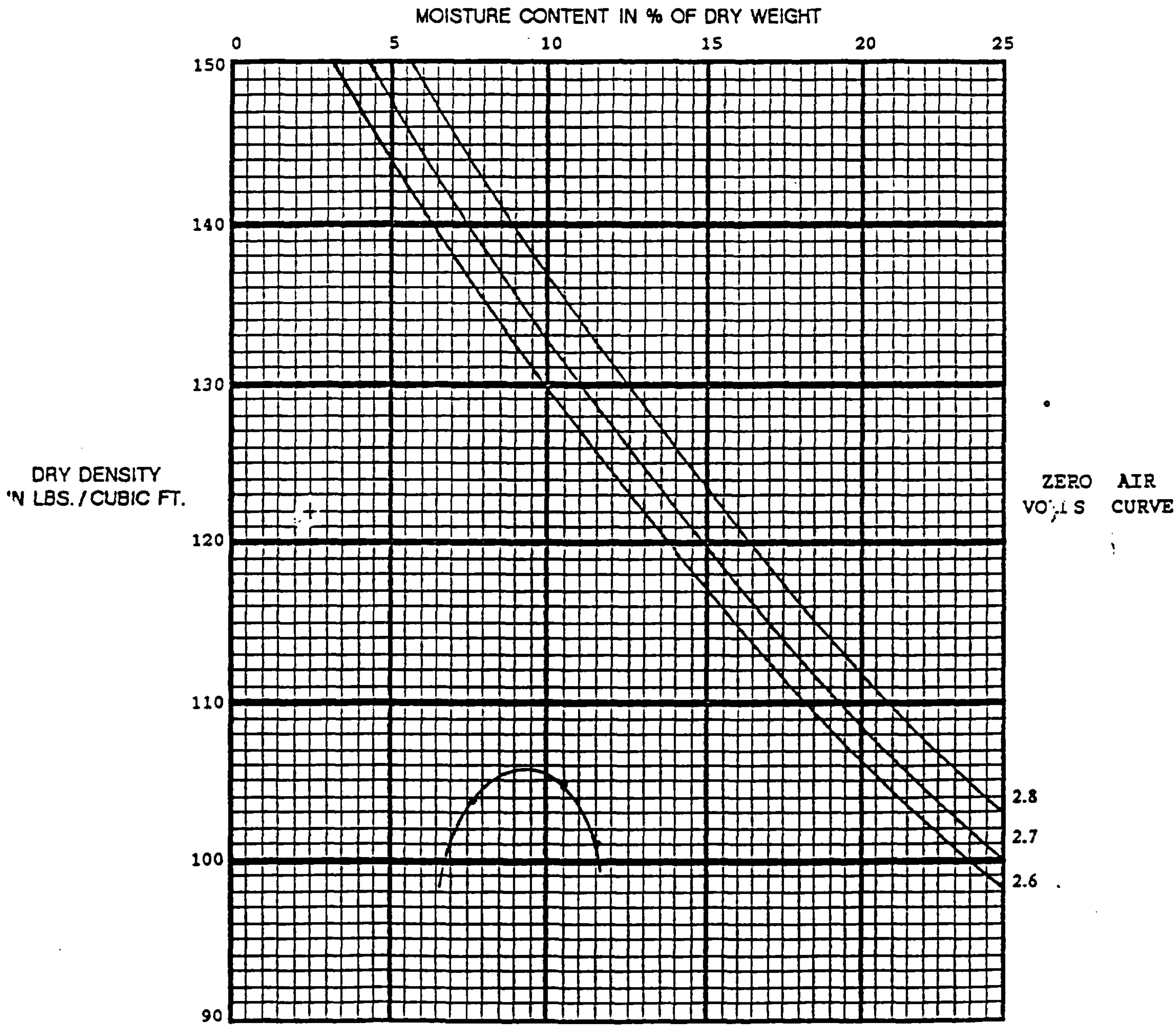
SOIL Fine Sand with some Gravel

LOCATION John Mansville

OPTIMUM MOISTURE CONTENT 9.3%

MAXIMUM DRY DENSITY 105.7#

METHOD OF COMPACTION ASTM D-1557



COMPACTION TEST DATA

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rev 11-28-88

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H. H. HOLMES TESTING LABORATORIES, INC.

Report No. 2

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

January 6, 1989

Lab No. CH 4447
File No. 6890.1

Mansville Corporation
P.O.Box 228
Waukegan, IL 60087

Attn: Tom Morrison

Re: John Mansville - Waukegan, IL

REPORT OF TESTS

Subject	:	Analysis of Fine Aggregate
Material	:	Fine Sand with some Gravel
Date Received	:	1-3-89
Method of Tests	:	ASTM C-40, D-698, G-51, C-136, D-422

TEST DATA

Sample No.	1
pH	6.8
Organic	None
Moisture (%)	0.8
Standard Proctor (lbs/ft^3)	105.7
Optimum Moisture	9.3
% Sand	96
% Silt	4
% Clay	0

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

• inspection
• evaluation
• research
construction materials

H. H. HOLMES TESTING LABORATORIES, INC.

Report No. 6

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

March 10, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

REPORT OF TESTS

Subject	:	Analysis of Fine Aggregate
Material	:	Fine Sand with Gravel
Date Received	:	3-6-89
Method of Test	:	A.S.T.M. C-40, D-698, C-51, C-136, D-422

TEST DATA

Asbestos	:	Not detected
pH	:	6.8
Organic	:	None*
Moisture (%)	:	4.6
Standard Proctor (lbs/ft^3)	:	105.5
Optimum Moisture	:	9.5
Sand (%)	:	94
Silt (%)	:	6
Clay (%)	:	0

*Sample contains some roots, which were removed before testing, but no other organic material was found.

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

APPENDIX A-2

CLAY

CRA/MANVILLE
WAUKEGAN, IL

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• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 8

June 1, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay
Date Received	:	5-19-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	Job Specifications
Source of Material	:	Grand Tri-State Office/Warehouse - Gurnee

TEST DATA

			Specifications
Asbestos	:	Not detected	
pH	:	6.7	
Organic (%)	:	3.1	$\leq$10%
Moisture (%)	:	19.5	
Proctor (lbs/ft^3)	:	115.4	
Optimum Moisture (%)	:	13.5	
Sand (%)	:	15	
Silt (%)	:	40	
Clay (%)	:	45	25- 60%
Passing #10 Sieve(%)	:	97	
Liquid Limit (%)	:	39	
Plastic Limit (%)	:	22	
Plasticity Index (%)	:	17	
Classification	:	CL	CL or ML-CL

Remarks: Material is approved for clay cover

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

Lake County Grading

#8

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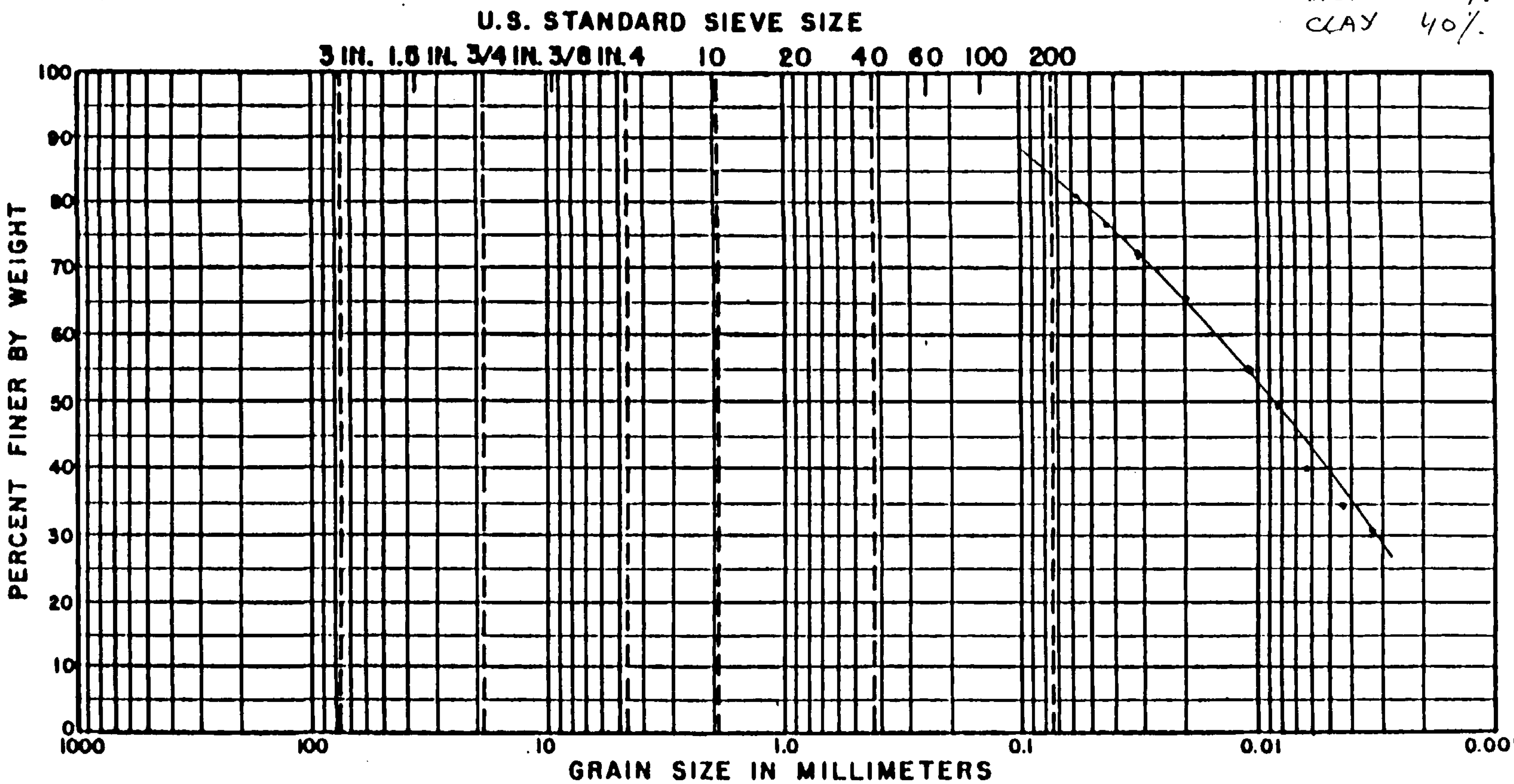
H. H. HOLMES TESTING LABORATORIES, INC.

SAND 15%
SILT 45%
CLAY 40%



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

GRADATION CURVE

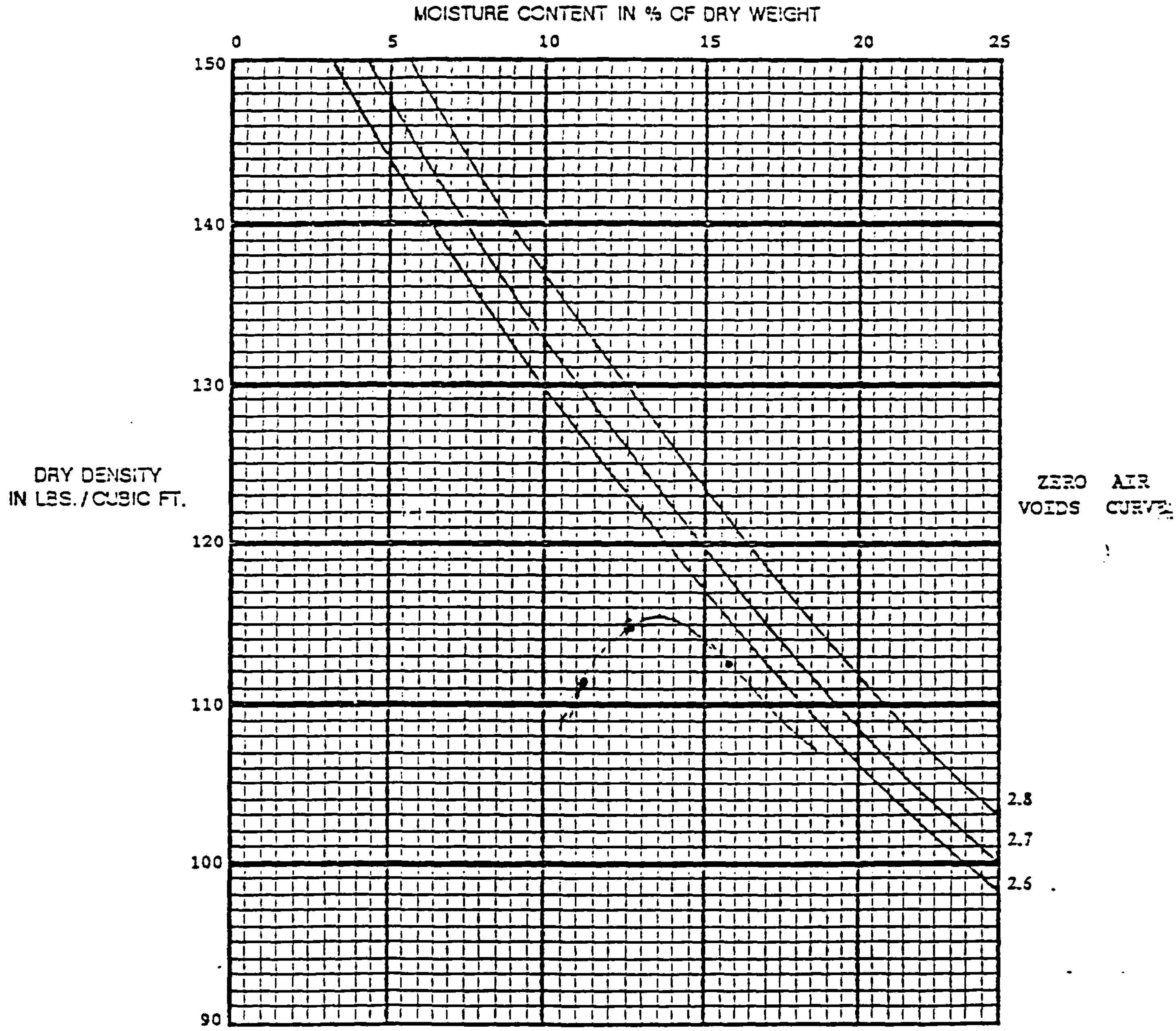
SOIL Brown Silty Clay

LOCATION Grand Tri State Office/Warehouse, Gurnee

OPTIMUM MOISTURE CONTENT 13.5%

MAXIMUM DRY DENSITY 115.4#

METHOD OF COMPACTION A.S.T.M. D-1557



COMPACTION TEST DATA

H. H. HOLMES TESTING LABORATORIES, INC.

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CRA/MANVILLE
WAUKEGAN, IL

JUN 22 1989

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H. H. HOLMES TESTING LABORATORIES, INC.

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 9

June 1, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay
Date Received	:	5-19-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	Job Specifications
Source of Material	:	Pembrook Shopping Center - Gurnee

TEST DATA

			Specifications
Asbestos	:	Not detected	
pH	:	6.6	
Organic (%)	:	3.6	$\leq$10%
Moisture (%)	:	14.6	
Proctor (lbs/ft^3)	:	123.0	
Optimum Moisture (%)	:	10.5	
Sand (%)	:	15	
Silt (%)	:	48	
Clay (%)	:	37	25- 60%
Passing #10 Sieve(%)	:	95	
Liquid Limit (%)	:	38	
Plastic Limit (%)	:	23	
Plasticity Index (%)	:	15	
Classification	:	CL	CL or ML-CL

Remarks: Material is approved for clay cover

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

Lake County Grading

#10

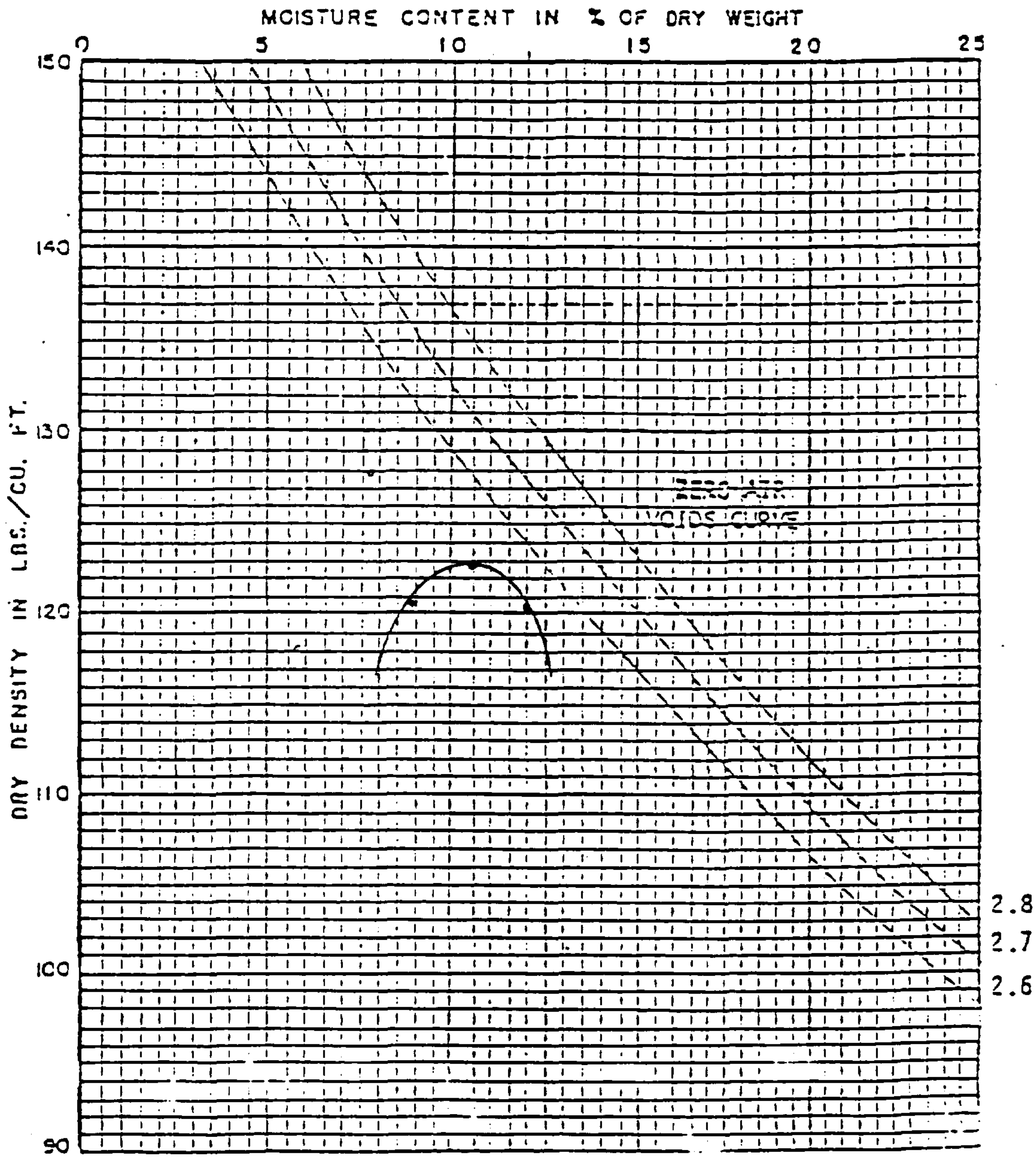
SOIL Brown Silty Clay

LOCATION Pembrook Shopping Center, Gurnee

OPTIMUM MOISTURE CONTENT 10.5%

MAXIMUM DRY DENSITY 123.0#

METHOD OF COMPACTION A.S.T.M. D-1557



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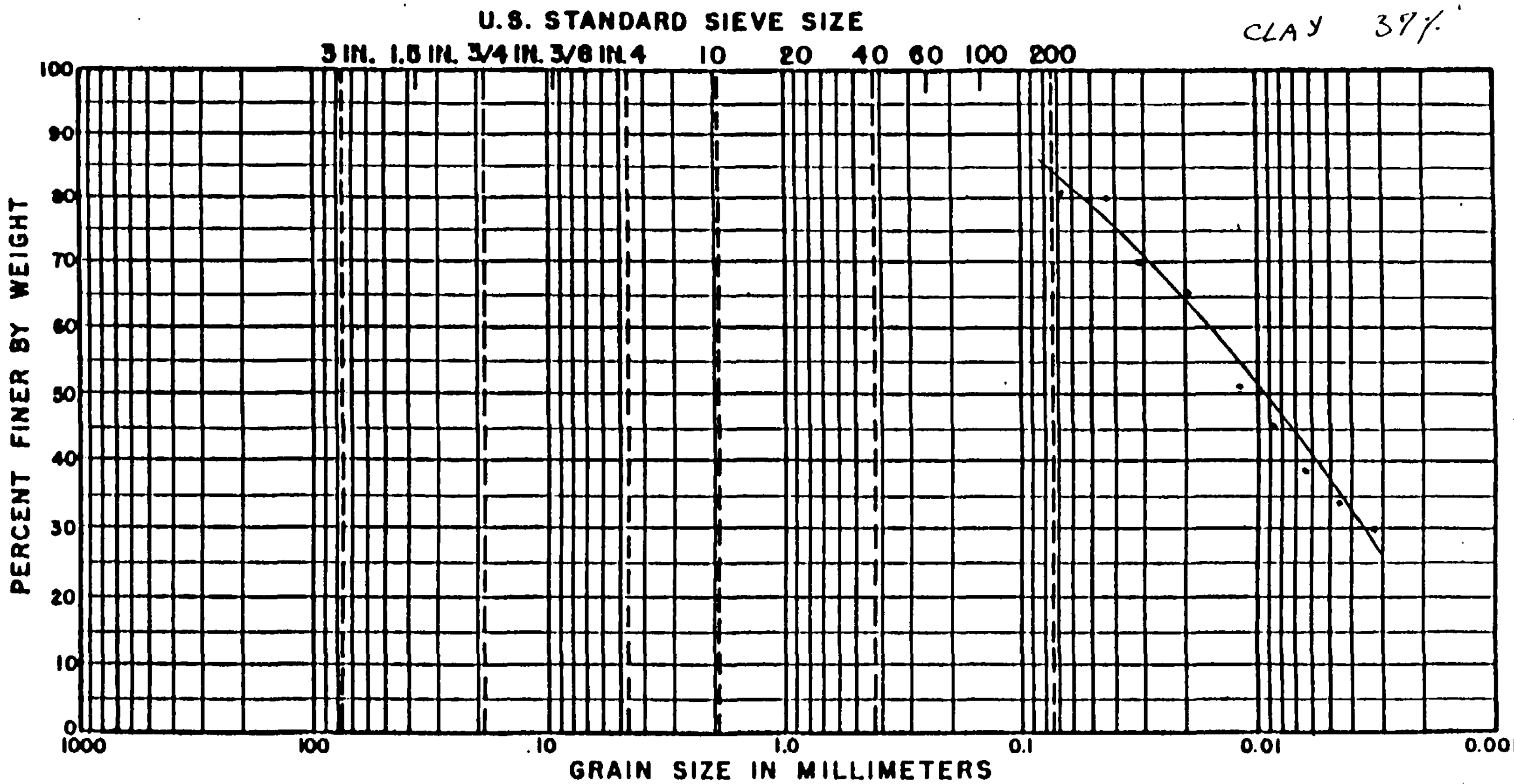
H. H. HOLMES TESTING LABORATORIES, INC.

SAND 15%
SILT 48%
CLAY 37%



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

GRADATION CURVE

CRA/MANVILLE
WAUKEGAN, IL

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CORRECTED
Report No. 10

June 2, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Gray Clayey Silt
Date Received	:	6-1-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	IDOT Article 717.04
Source of Material	:	Rte. 137 & Sheridan Road

TEST DATA

				Specifications
	Asbestos	:	Not detected	
	pH	:	6.7	
	Organic (%)	:	2.1	$\leq$10%
	Moisture (%)	:	13.0	
	Proctor (lbs/ft^3)	:	128.4	
	Optimum Moisture (%)	:	10.5	
	Sand (%)	:	19	
	Silt (%)	:	52	
	Clay (%)	:	29	25- 60%
#10 = 2.0mm	Passing #10 Sieve(%)	:	96	
	Liquid Limit (%)	:	24	
	Plastic Limit (%)	:	14	
	Plasticity Index (%)	:	10	
	Classification	:	CL	CL or ML-CL

Remarks: Material is approved for clay cover

Respectfully submitted,

Richard E. Nelson Jr./pbn

Richard E. Nelson, Jr.
President

Todd R Nelson

Todd R. Nelson
Laboratory Manager

REN/pbn

Lake Co. Grading

#10

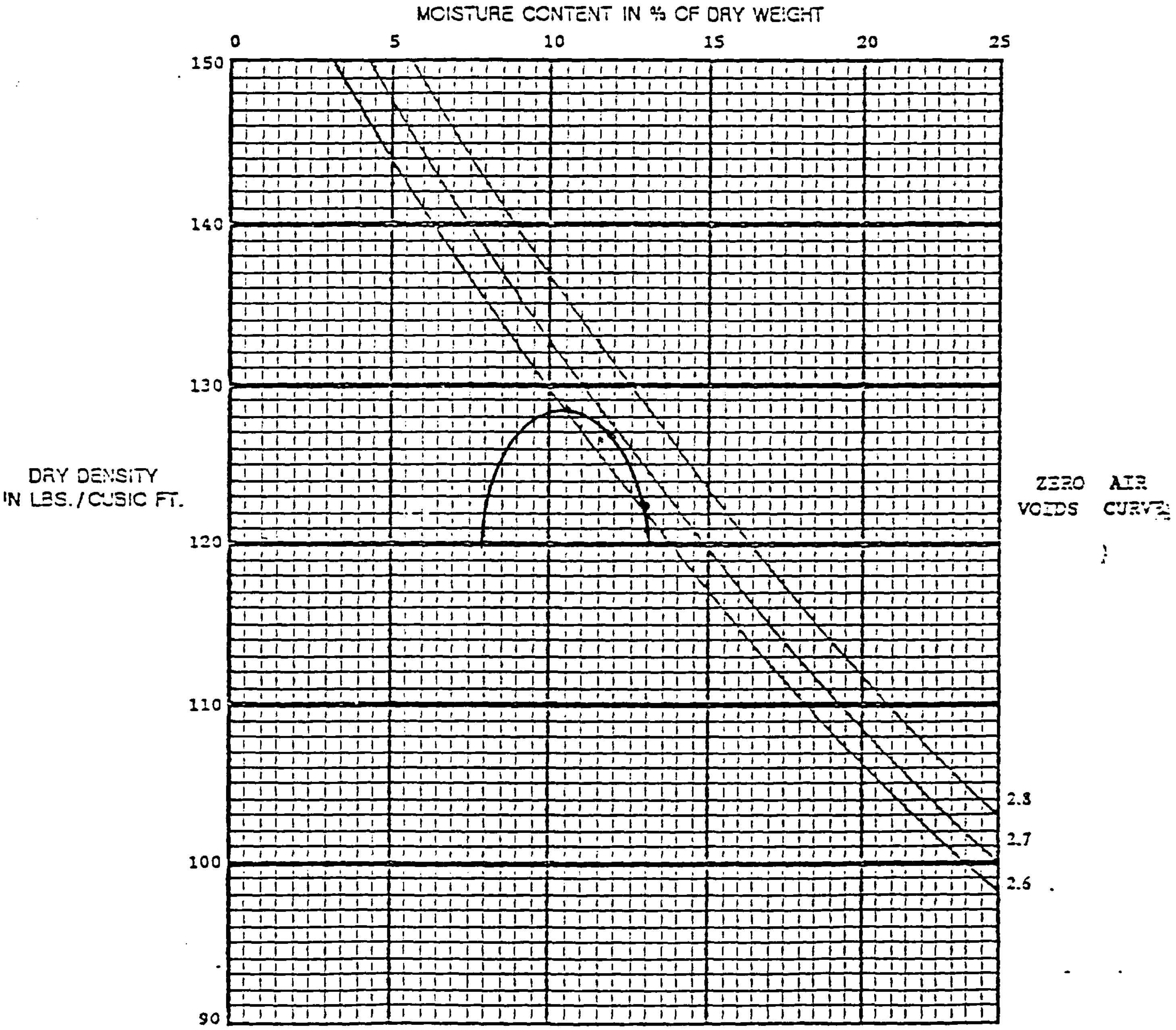
SOIL Gray Clayey Silt

LOCATION Rte 137 & Sheridan

OPTIMUM MOISTURE CONTENT 10.5%

MAXIMUM DRY DENSITY 128.4#

METHOD OF COMPACTION ASTM D-1557



COMPACTION TEST DATA

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rev 11-25-88

#10

Lak[illegible] unty Grading

H. H. HOLMES TESTING LABORATORIES, INC.

• [illegible]ection
• evaluation
• research

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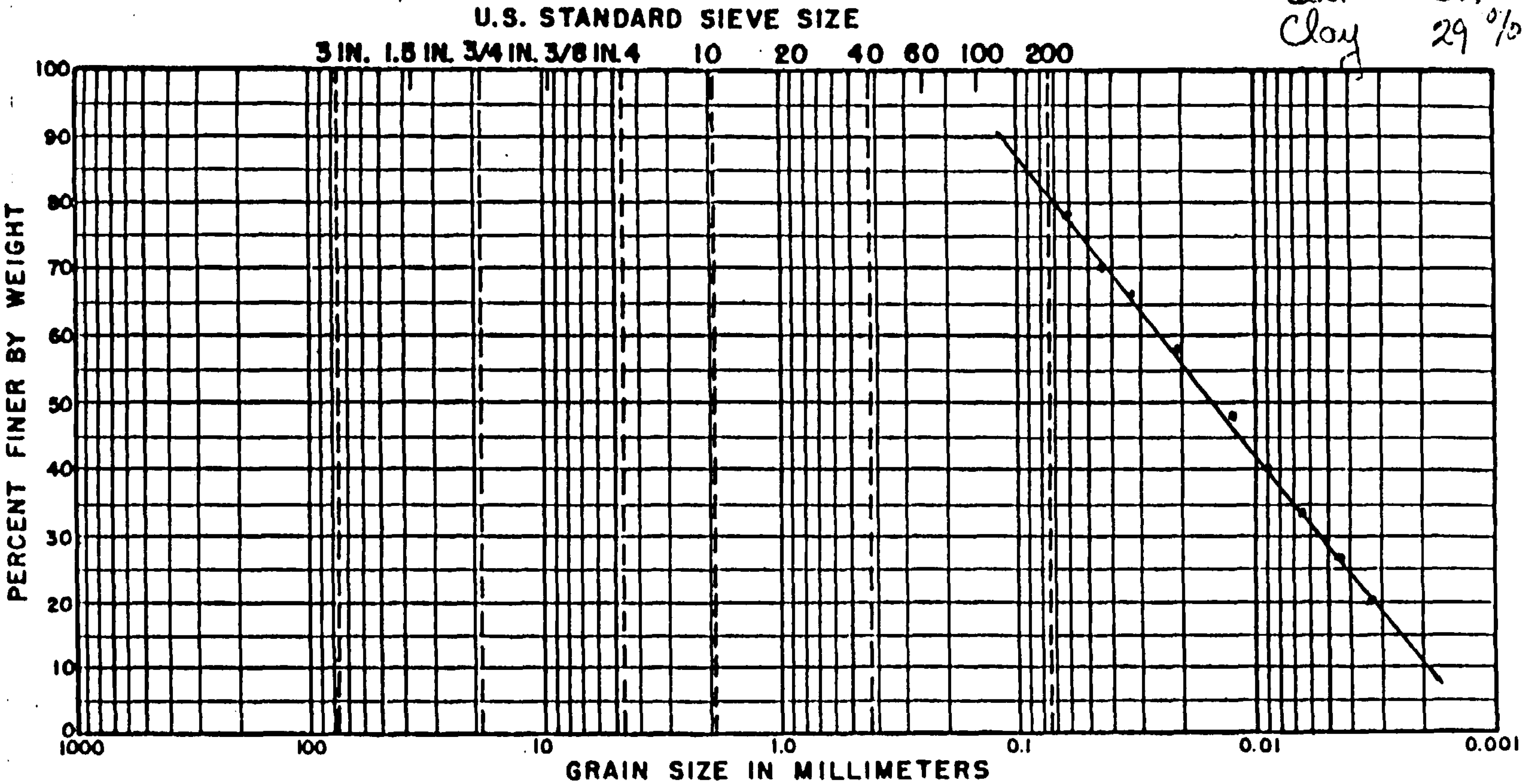
Sand 14%
Silt 52%
Clay 29%



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

GRADATION CURVE

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H. H. HOLMES TESTING LABORATORIES, INC.

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 11

June 28, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL

JUN 29 1989

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REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay trace Gravel
Date Received	:	6-19-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	IDOT Article 717.04
Source of Material	:	Yorkhouse Road

TEST DATA

			Specifications
Asbestos	:	None detected	
pH	:	6.7	
Organic (%)	:	2.1	≤10%
Moisture (%)	:	14.5	
Proctor (lbs/ft^3)	:	*	
Optimum Moisture (%)	:	*	
Sand (%)	:	7.0	
Silt (%)	:	45	
Clay (%)	:	48	25- 60%
Passing #10 Sieve(%)	:	95	
Liquid Limit (%)	:	39	
Plastic Limit (%)	:	18	
Plasticity Index (%)	:	21	
Classification	:	CL	CL or ML-CL

* Sample too small to determine values

Remark: Material is approved for clay cover

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

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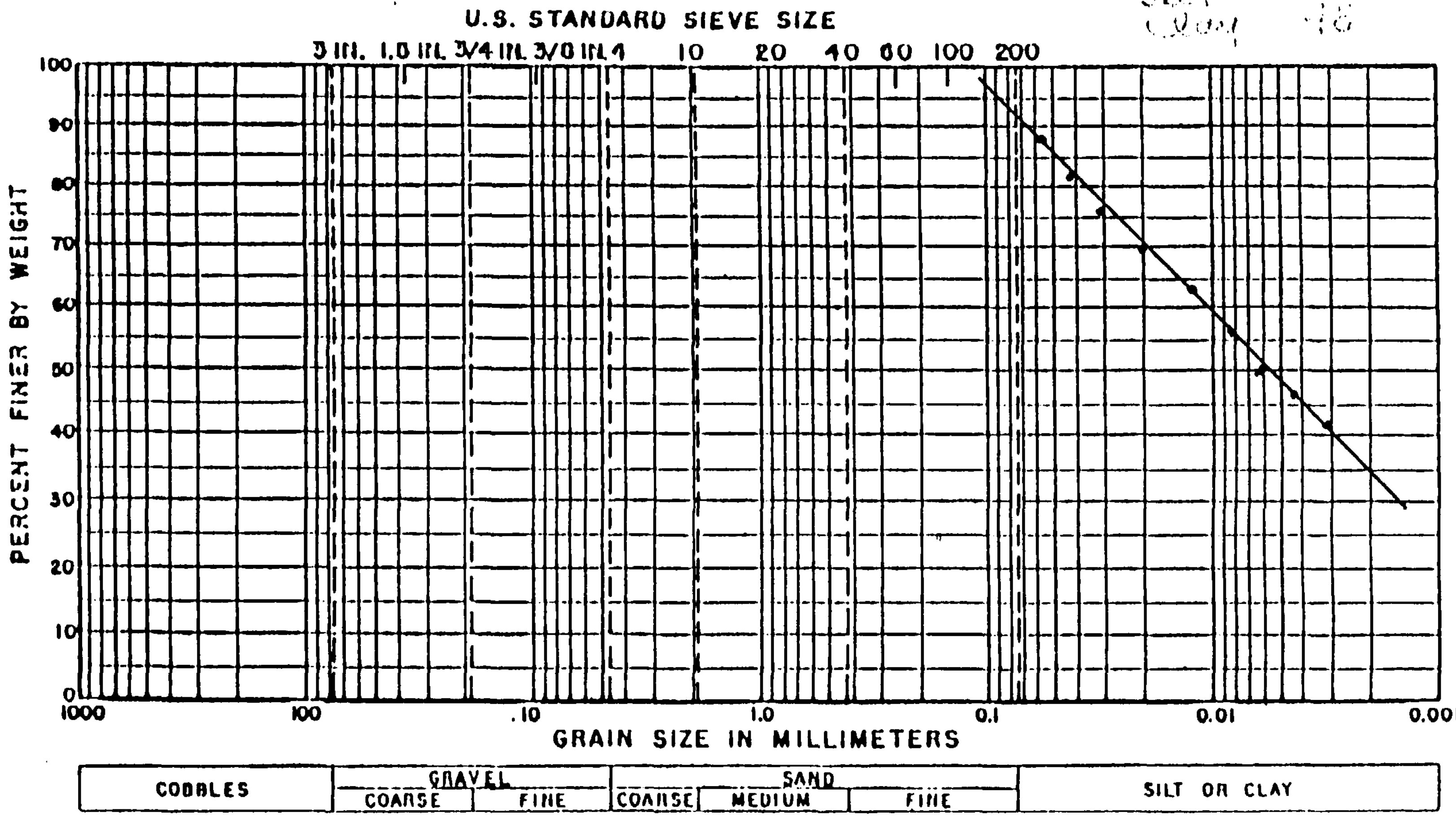
H. H. HOLMES TESTING LABORATORIES, INC.

Sand 7
Silt 45
Clay 48



	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

GRADATION CURVE

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H. H. HOLMES TESTING LABORATORIES, INC.

Report No. 16 • 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4010

July 10, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O. Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL
JUL 11 1989
RECEIVED

REPORT OF TESTS

Subject	: Analysis of Soil
Material	: Brown Silty Clay
Date Received	: 7-3-89
Method of Test	: ASTM C-40, D-698, C-51, C-422
Specifications	: IDOT Article 717.04
Source of Material	: Rte 137

	TEST DATA	Specifications
Asbestos	: None detected	
pH	: 6.5	
Organic (%)	: 2.4	≤10%
Moisture (%)	: 9.5	
Standard Proctor (Lbs/ft^3)	: 122.1	
Optimum Moisture (%)	: 12.0	
Sand (%)	: 24	
Silt (%)	: 49	
Clay (%)	: 27	25-60%
Passing #10 Sieve (%)	: 92	
Liquid Limit (%)	: 26	
Plastic Limit (%)	: 14	
Plasticity Index (%)	: 12	
Classification	: CL	CL or ML-CL

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pls

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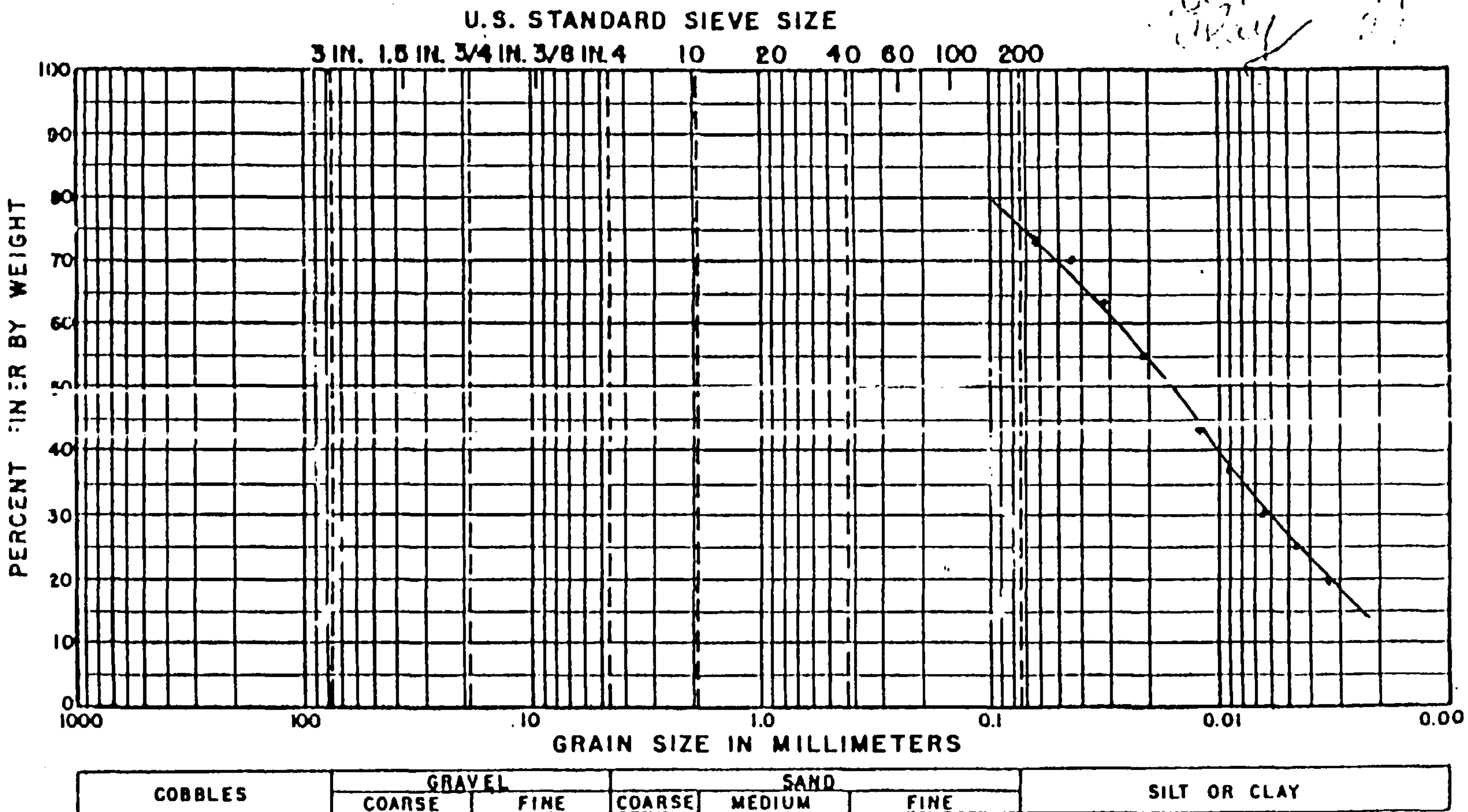
H. H. HOLMES TESTING LABORATORIES, INC.



	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

RTE. 137

GRADATION CURVE

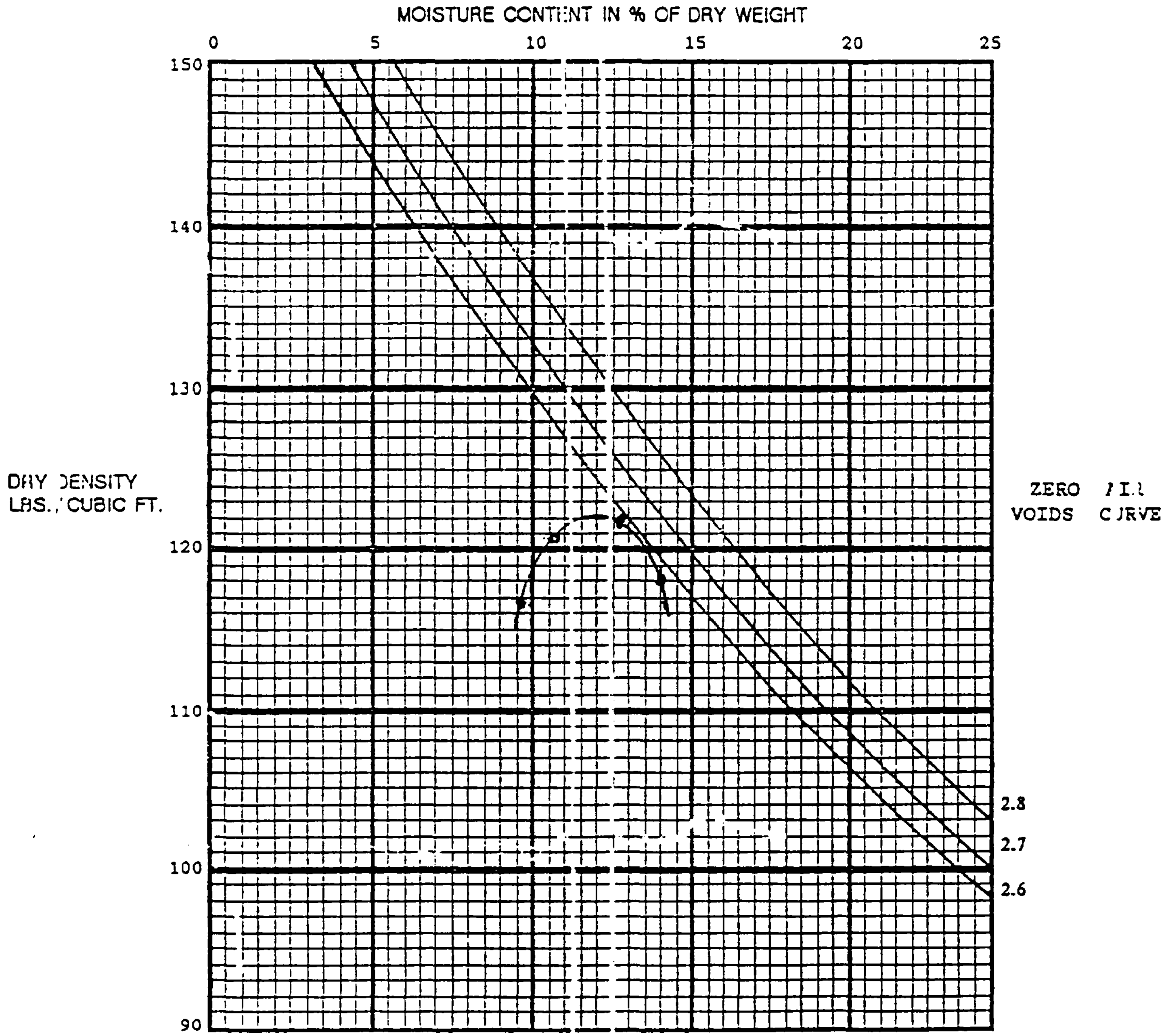
SOIL Brown Silty Clay

LOCATION Rte 137

OPTIMUM MOISTURE CONTENT 12.0%

MAXIMUM DRY DENSITY 122.1#

METHOD OF COMPACTION D-698



COMPACTION TEST DATA

H. H. HOLMES TESTING LABORATORIES, INC.

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H. H. HOLMES TESTING LABORATORIES, INC.

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• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 18

July 13, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL
JUL 17 1989
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REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay, trace Gravel
Date Received	:	7-7-89
Method of Test	:	ASTM C-40,D-698, C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Fort Sheridan

TEST DATA

			Specifications
Asbestos	:	None Detected	
pH	:	6.6	
Organic (%)	:	3.0	$\leq$10%
Moisture (%)	:	10.0	
Stnd Proctor (lbs/ft^3)	:	121.0	
Optimum Moisture (%)	:	12.4	
Sand (%)	:	11	
Silt (%)	:	53	
Clay (%)	:	36	25- 60 %
Passing No. 10 Sieve (%) (2.0 mm)	:	96	
Liquid Limit (%)	:	29	
Plastic Limit (%)	:	14	
Plasticity Index(%)	:	15	
Classification	:	CL	CL or ML-CL

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

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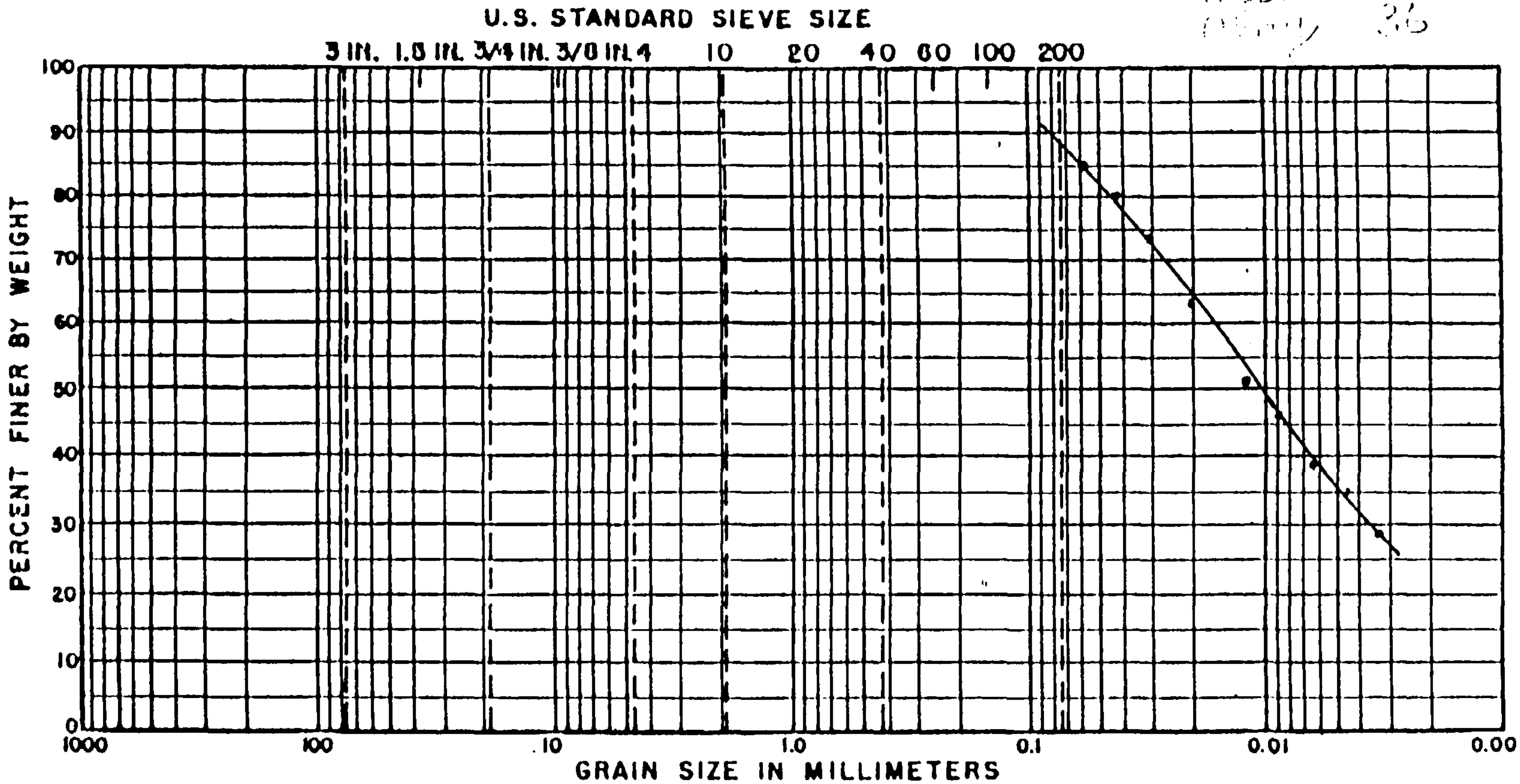
Sand 11
Silt 53
Clay 36



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

GRADATION CURVE

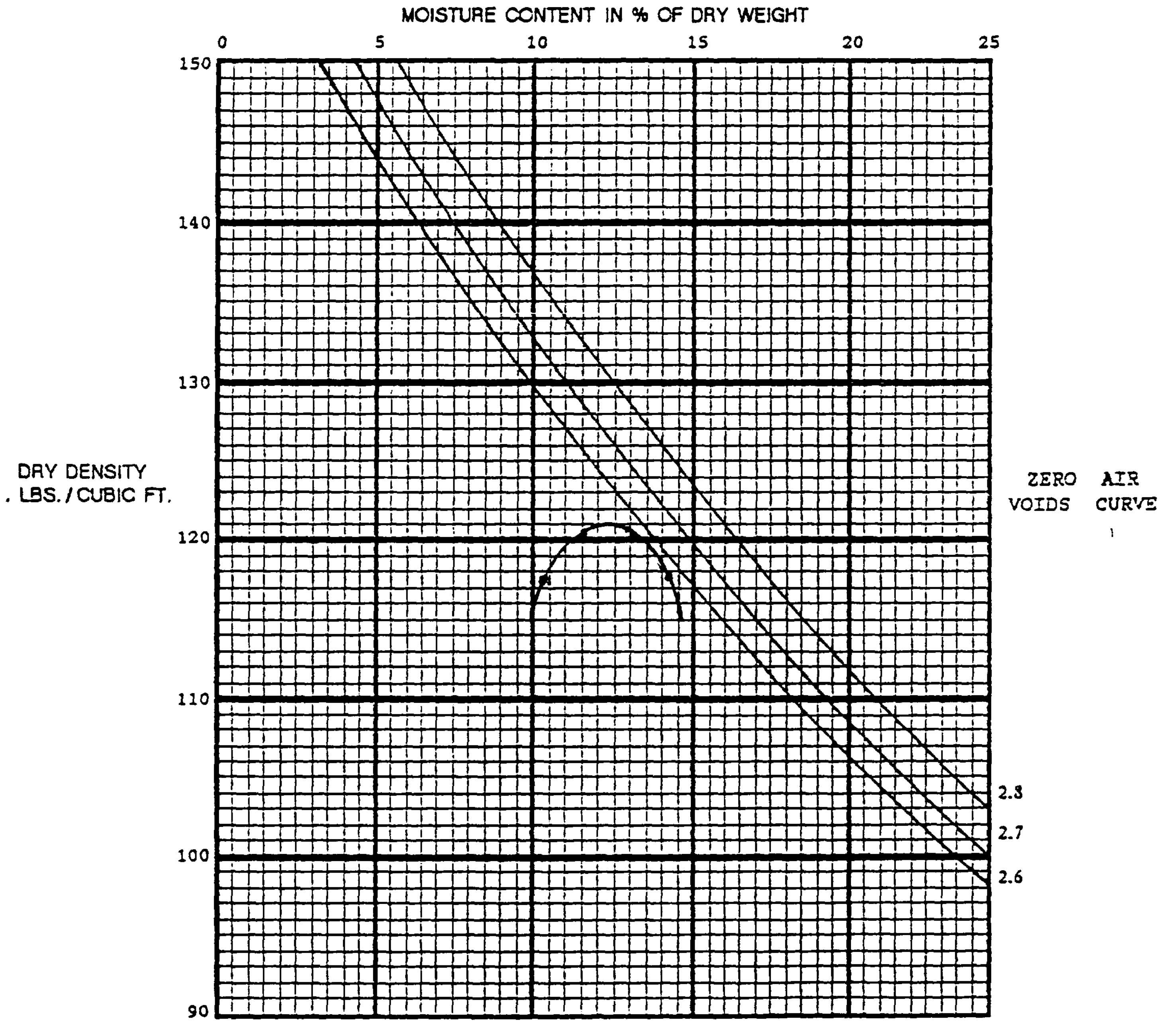
SOIL ______________________________

LOCATION ______________________________

OPTIMUM MOISTURE CONTENT ______________________________

MAXIMUM DRY DENSITY ______________________________

METHOD OF COMPACTION ______________________________



COMPACTION TEST DATA

H. H. HOLMES TESTING LABORATORIES, INC.

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- evaluation
- research

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• evaluation
• research

construction materials

H. H. HOLMES TESTING LABORATORIES, INC.

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 19

August 9, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay trace Gravel
Date Received	:	8-4-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Skokie Lagoon

TEST DATA

			Specifications
Asbestos	:	None detected	
pH	:	6.8	
Organic (%)	:	3.2	$\leq$ 10%
Moisture (%)	:	22.7	
Standard Proctor (lbs/ft^3)	:	109.5	
Optimum Moisture (%)	:	15.2	
Sand (%)	:	14	
Silt (%)	:	43	
Clay (%)	:	43	25-60%
Passing No. 10 Sieve (%) 2.0 mm	:	90	
Liquid Limit (%)	:	35	
Plastic Limit (%)	:	19	
Plasticity Index (%)	:	16	
Classification	:	CL	CL or ML-CL

Respectfully submitted,

Richard E. Nelson Jr. /B

Richard E.Nelson,Jr.
President

Todd R.Nelson
Laboratory Manager

CRA/MANVILLE
WAUKEGAN, IL

SEP 5 1989

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Skokie Lagoon

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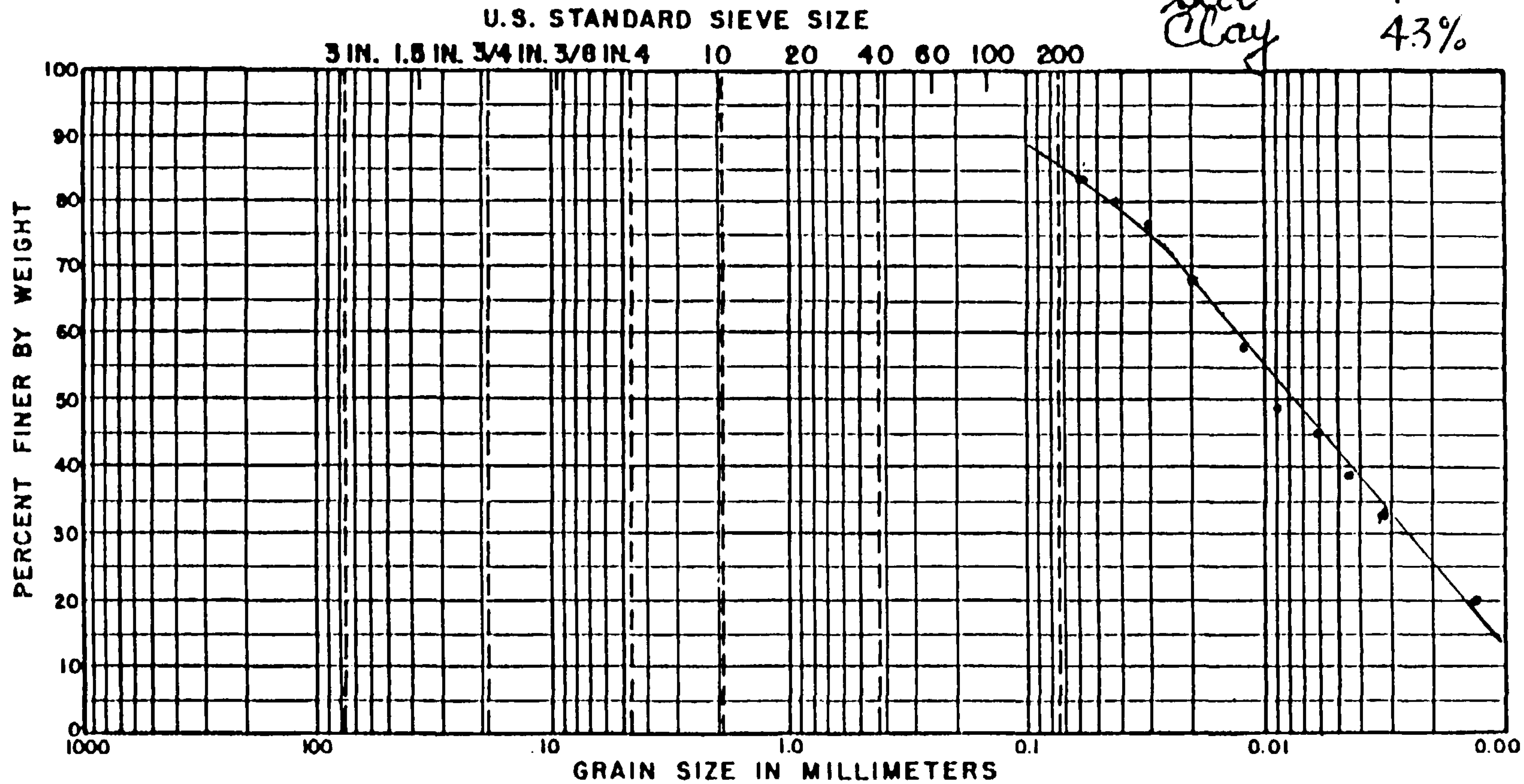
H. H. HOLMES TESTING LABORATORIES, INC.

Sand 14%
Silt 43%
Clay 43%



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

GRADATION CURVE

H. H. HOLMES TESTING LABORATORIES, INC.

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Report No. 20

August 9, 1989

Lab No. CH 4325
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay trace Gravel
Date Received	:	8-4-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Fort Sheridan

TEST DATA

			Specifications
Asbestos	:	None detected	
pH	:	6.7	
Organic (%)	:	1.6	$\leq$ 10%
Moisture (%)	:	17.1	
Standard Proctor (lbs/ft^3)	:	114.8	
Optimum Moisture (%)	:	11.5	
Sand (%)	:	12	
Silt (%)	:	53	
Clay (%)	:	35	25-60%
Passing No. 10 Sieve (%) 2.0 mm	:	92	
Liquid Limit (%)	:	20	
Plastic Limit (%)	:	12	
Plasticity Index (%)	:	8	
Classification	:	CL	CL or ML-CL

Respectfully submitted,

Richard E. Nelson Jr.

Richard E.Nelson,Jr.
President

Todd R.Nelson
Laboratory Manager

CRA/MANVILLE
WAUKEGAN, IL
SEP 5 1989
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Fort Sheridan

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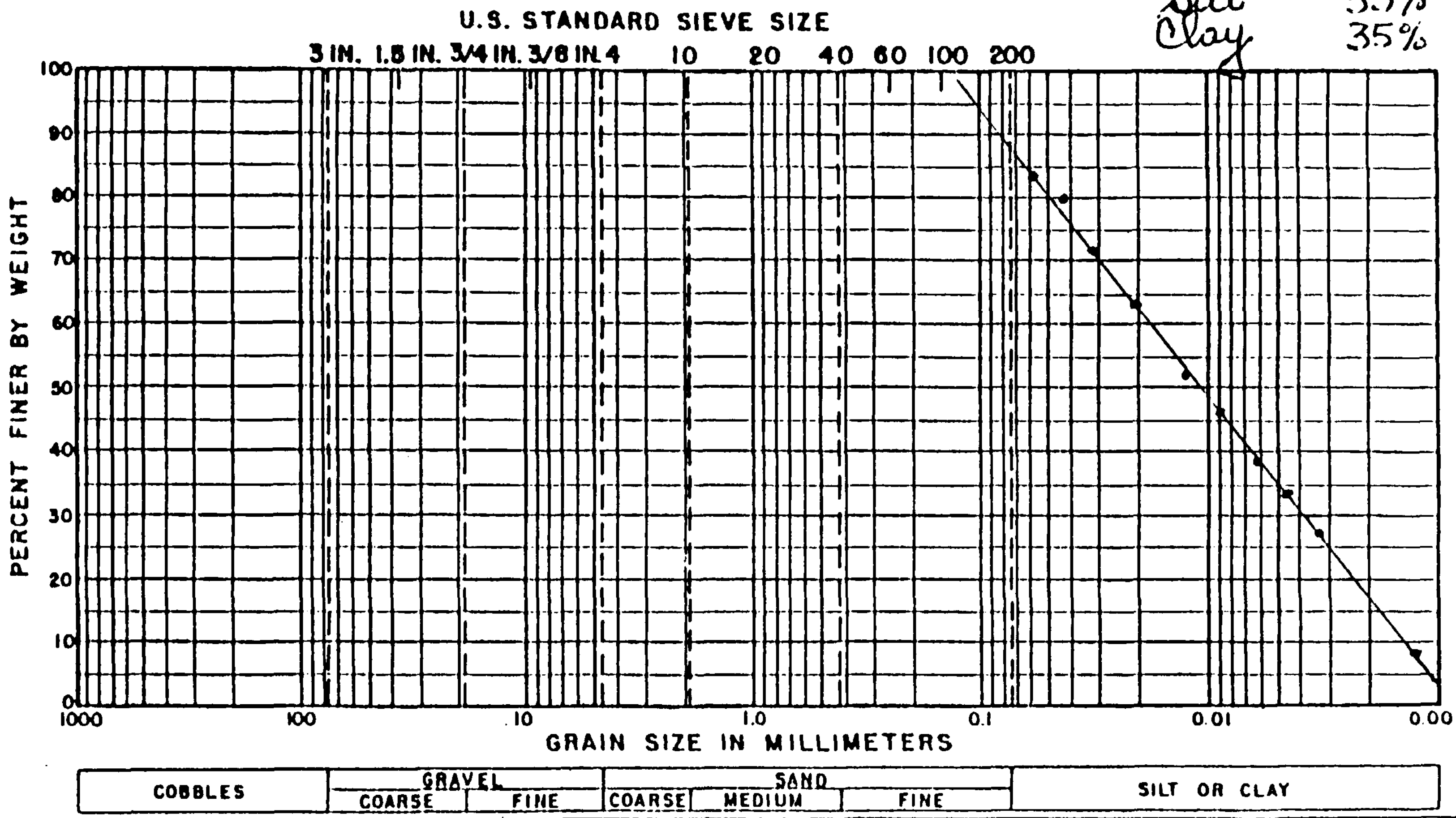
H. H. HOLMES TESTING LABORATORIES, INC.

Sand 12%
Silt 53%
Clay 35%



	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

GRADATION CURVE

H. H. HOLMES TESTING LABORATORIES, INC.

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• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 21

October 2, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O. Box L
Libertyville, Illinois 60048

Re: John Mansville - Waukegan, IL

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay
Date Received	:	9-15-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Tristate Pond

TEST DATA

			Specifications
Asbestos	:	< 1%*	
pH	:	6.8	
Organic (%)	:	6.0	≤ 10%
Moisture (%)	:	11.8	
Standard Proctor(lbs/ft^3)	:	115.7	
Optimum Moisture (%)	:	13.4	
Sand (%)	:	16	
Silt (%)	:	51	
Clay (%)	:	33	25-60%
Passing #10 Sieve(%)2.0 mm	:	93	
Liquid Limit (%)	:	32.3	
Plastic Limit (%)	:	17.7	
Plasticity Index (%)	:	14.6	
Classification	:	CL	CL or ML-CL

*See Enclosure

Respectfully submitted,

Richard E. Nelson, Jr./BL

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/bal

CRA/MANVILLE
WAUKEGAN, IL

OCT 4 1989

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Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

SAMPLE SOURCE
NAME: HOLMES TESTING LAB
ADDRESS:

COLLECTED BY:
DATE COLLECTED:
DATE RECEIVED:
BY: MFL

COMPOSITION / SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
HTL-1		BRN	Y	*	—	—	—	—	—	5							94+	DIRT

I. PURPOSE

Mr. Jim Bernardi of Holmes Testing Laboratories, engaged Micro-Fiber Laboratories, Inc., to analyze one (1) suspect asbestos bulk soil sample.

II. ANALYTICAL METHOD

The sample was analyzed using polarized light microscopy with EPA recommended central stop dispersion staining.

III. RESULTS

Sample No.	Location	Material
HTL-1		* <1% asbestos; Cellulose, 5%; Dirt, 94+%

* Denotes non-asbestos containing material.

It is recommended practice that floor tile be analyzed by TEM methods for positive identification of asbestos content. The PLM method may not always be accurate.

(This report can be reproduced in its entirety. This report relates to only the items tested and any conclusions regarding this data, other than those drawn by Micro-Fiber Laboratories, Inc., may not be valid.)

Micro-Fib... Laboratories, Inc.
625 Landwehr Road, Northbrook, IL 60062
(312) 498-4127
1-800-82-MICRO (312 Area Code)
1-800-373-LABS (Outside 312 Area Code)
FAX (312) 498-4453

HOLMES TESTING LABORATORIES

170 Shepard Avenue
Wheeling, Illinois 60090

Prepared By:

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, Illinois 60062
(312) 498-4127

September 26, 1989

H. H. HOLMES TESTING LABORATORIES, INC.

• inspection • evaluation • research
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• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 24

October 26, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL
NOV 1 1989
RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay
Date Received	:	10-19-89
Method of Test	:	ASTM C-40,C-698,C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Grandview (Lake County)

TEST DATA

			Specifications
Asbestos	:	Non-Asbestos Containing Material	
pH	:	6.7	
Organic (%)	:	3.8	≤10%
Moisture (%)	:	14.3	
Standard Proctor	:	115.8 lbs/ft³	
Optimum Moisture (%)	:	14.8	
Sand (%)	:	17	
Silt (%)	:	44	
Clay (%)	:	39	25-60%
Passing No. 10 Sieve (%) (2.0 mm)	:	94.3	
Liquid Limit (%)	:	30	
Plastic Limit (%)	:	19	
Plasticity Index(%)	:	11	
Classification	:	CL	CL or ML-CL

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Vice President

REN/pbn

Micro-Fiber Laboratories, Inc.
625 Landwehr Road, Northbrook, IL 60062
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HOLMES TESTING LABORATORIES

170 Shepard Avenue
Wheeling, Illinois 60090

Prepared By:

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, Illinois 60062
(312) 498-4127

October 23, 1989

I. PURPOSE

Mr. Jim Bernardi of Holmes Testing Laboratories, engaged Micro-Fiber Laboratories, Inc., to analyze one (1) suspect asbestos bulk soil sample.

II. ANALYTICAL METHOD

The sample was analyzed using polarized light microscopy with EPA recommended central stop dispersion staining.

III. RESULTS

Sample No.	Location	Material
2357	Grandview/Clay	* <1% asbestos; Cellulose, 2%; Rock, Soil, 97+%

* Denotes non-asbestos containing material.

It is recommended practice that floor tile be analyzed by TEM methods for positive identification of asbestos content. The PLM method may not always be accurate.

(This report can be reproduced in its entirety. This report relates to only the items tested and any conclusions regarding this data, other than those drawn by Micro-Fiber Laboratories, Inc. may not be valid.)

Reviewed:

Robert G. Cooley

Robert G. Cooley
President

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

SAMPLE SOURCE

NAME: HOLMES TESTING LABS
ADDRESS: 170 SHEPARD AVE.
WHEELING, IL 60091

GRANDVIEW CLAY

COLLECTED BY:
DATE COLLECTED:
DATE RECEIVED: 10-20-89
BY: M.F.L.

COMPOSITION / SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
2357		BROWN	Y	N						2							97+	ROCK, SOIL

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING.

*DENOTES NOT ASBESTOS CONTAINING MATERIAL

ANALYST (SIGNATURE) Lawrence Gleason 10-23-89

ANALYST (PRINTED) LAWRENCE GLEASON

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H. H. HOLMES TESTING LABORATORIES, INC.

170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 25

October 26, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL

NOV 1 1989

RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Sandy Silty Clay
Date Received	:	10-17-89
Method of Test	:	ASTM C-40,C-698,C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Lake County (Sunset & Hawthorne Roads) Hawthorne Ct.

TEST DATA

			Specifications
Asbestos	:	Non-Asbestos Containing Material	
pH	:	6.8	
Organic (%)	:	5.1	10%
Moisture (%)	:	8.6	
Standard Proctor	:	119.2 lbs/ft^3	
Optimum Moisture (%)	:	12.7	
Sand (%)	:	28	
Silt (%)	:	43	
Clay (%)	:	25	25-60%
Passing No. 10 Sieve (%) (2.0 mm)	:	94	
Liquid Limit (%)	:	26	
Plastic Limit (%)	:	16	
Plasticity Index(%)	:	10	
Classification	:	CL	CL or ML-CL

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Vice President

REN/pbn

Micro-Fiber Laboratories, Inc.
625 Landwehr Road, Northbrook, IL 60062
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HOLMES TESTING LABORATORIES

170 Shepard Avenue
Wheeling, Illinois 60090

Prepared By:

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, Illinois 60062
(312) 498-4127

October 21, 1989

I. PURPOSE

Mr. Jim Bernardi of Holmes Testing Laboratories, engaged Micro-Fiber Laboratories, Inc., to analyze one (1) suspect asbestos bulk soil sample.

II. ANALYTICAL METHOD

The sample was analyzed using polarized light microscopy with EPA recommended central stop dispersion staining.

III. RESULTS

Sample No.	Location	Material
1		* <1% asbestos; Cellulose, 2%; Soil, 97+%

* Denotes non-asbestos containing material.

It is recommended practice that floor tile be analyzed by TEM methods for positive identification of asbestos content. The PLM method may not always be accurate.

(This report can be reproduced in its entirety. This report relates to only the items tested and any conclusions regarding this data, other than those drawn by Micro-Fiber Laboratories, Inc. may not be valid.)

Reviewed:

Robert G. Cooley

Robert G. Cooley
President

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

SAMPLE SOURCE

NAME: Holmes Testing Labs
ADDRESS: 170 Shepard Ave
Wheeling, IL 60091

COLLECTED BY:
DATE COLLECTED:
DATE RECEIVED: 10-17-89
BY: M.F.L.

COMPOSITION / SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
1		Brown	Y	N	—	—	—	—	—	2	—	—	—	—	—	—	97+	Soil

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING.

*DENOTES NOT ASBESTOS CONTAINING MATERIAL.

ANALYST (SIGNATURE) Lawrence Gleason 10-18-89

ANALYST (PRINTED) Lawrence Gleason

H. H. HOLMES TESTING LABORATORIES, INC.

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Report No. 26

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

November 15, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O. Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

REPORT OF TESTS

CRA/MANVILLE
WAUKEGAN, IL

NOV 20 1989

RECEIVED

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay
Date Received	:	10-30-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Hundi/Washington/41

TEST DATA

			Specifications
Asbestos	:	Non-asbestos containing material	
pH	:	6.8	
Organic (%)	:	5.5	$\leq$ 10%
Moisture (%)	:	9.7	
Standard Proctor (lbs/ft^3)	:	111.7	
Optimum Moisture (%)	:	12.8	
Sand (%)	:	12	
Silt (%)	:	54	
Clay (%)	:	34	25-60%
Passing #10 Sieve (%) 2.0 mm	:	91	
Liquid Limit (%)	:	30.2	
Plastic Limit (%)	:	17.1	
Plasticity Index (%)	:	13.1	
Classification	:	CL	CL or ML-CL

Respectfully submitted,

Richard E. Nelson, Jr.

Todd R. Nelson

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

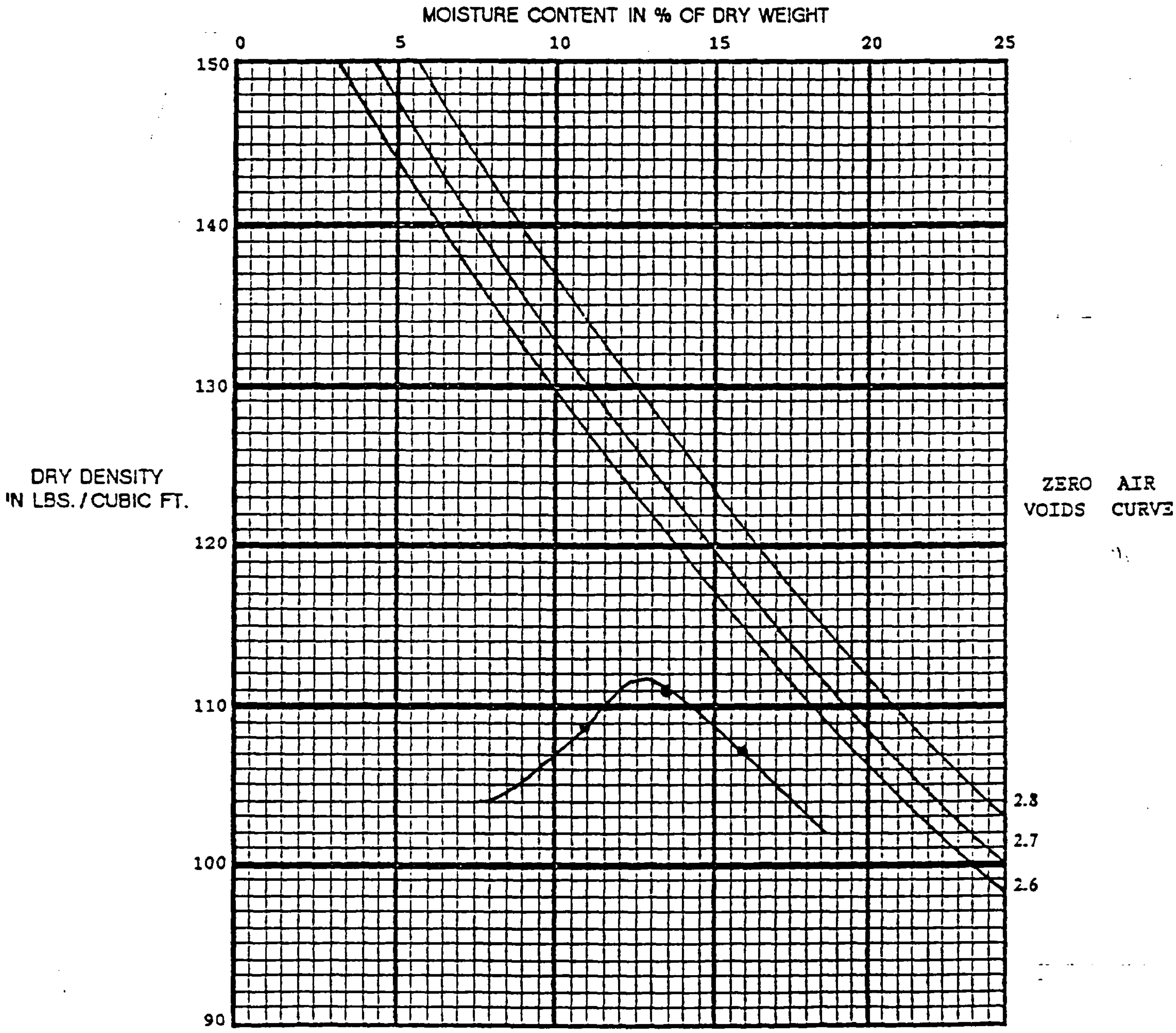
SOIL Brown Silty Clay

LOCATION Hundi/Washington/41

OPTIMUM MOISTURE CONTENT 12.8%

MAXIMUM DRY DENSITY 111.7#

METHOD OF COMPACTION ASTM D-698



COMPACTION TEST DATA

H. H. HOLMES TESTING LABORATORIES, INC.

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Micro-Fiber Laboratories, Inc.
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HOLMES TESTING LABORATORIES

170 Shepard Avenue
Wheeling, Illinois 60090

Prepared By:

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, Illinois 60062
(708) 498-4127

November 1, 1989

I. PURPOSE

Mr. Jim Bernardi of Holmes Testing Laboratories, engaged Micro-Fiber Laboratories, Inc., to analyze one (1) suspect asbestos bulk soil sample.

II. ANALYTICAL METHOD

The sample was analyzed using polarized light microscopy with EPA recommended central stop dispersion staining.

III. RESULTS

Sample No.	Location	Material
1		* <1% asbestos; Cellulose, 6%; Soil, Rock, 93+%

* Denotes non-asbestos containing material.

It is recommended practice that floor tile be analyzed by TEM methods for positive identification of asbestos content. The PLM method may not always be accurate.

(This report can be reproduced in its entirety. This report relates to only the items tested and any conclusions regarding this data, other than those drawn by Micro-Fiber Laboratories, Inc.. may not be valid.)

Reviewed:

Robert G. Cooley

Robert G. Cooley
President

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

SAMPLE SOURCE

NAME: HOLMES TESTING LABS
ADDRESS:

COLLECTED BY:
DATE COLLECTED:
DATE RECEIVED: 10-31-89
BY: M.F.L.

HUNDI/WASHINGTON/41 LAKE COUNTY GRADING

SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
1		BROWN	Y	N						6							93+	SOIL, ROCK

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING.

*DENOTES NOT ASBESTOS CONTAINING MATERIAL

ANALYST (SIGNATURE) Lawrence Gleason 11-1-89
ANALYST (PRINTED) LAWRENCE GLEASON

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H. H. HOLMES TESTING LABORATORIES, INC.

• 170 Shepard Avenue • Wheeling, Illinois 60090 • 708 • 541-4040 • Fax: 708 • 537-9098

Report No. 27

April 13, 1990

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL

APR 17 1990

RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay (#2)
Date Received	:	4-6-90
Method of Test	:	ASTM C-40,C-698,C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Abbott

TEST DATA

			Specifications
Asbestos	:	Non-Asbestos Containing Material	
pH	:	6.6	
Organic (%)	:	1.5	$\leq$10%
Moisture (%)	:	12.7	
Standard Proctor	:	110.3 lbs/ft^3	
Optimum Moisture (%)	:	16.7	
Sand (%)	:	6	
Silt (%)	:	39	
Clay (%)	:	55	25-60%
Passing No. 10	:		
Sieve (%) (2.0 mm)	:	95	
Liquid Limit (%)	:	31	
Plastic Limit (%)	:	18	
Plasticity Index(%)	:	13	
Classification	:	CL	CL or ML-CL

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Vice President

REN/pbn

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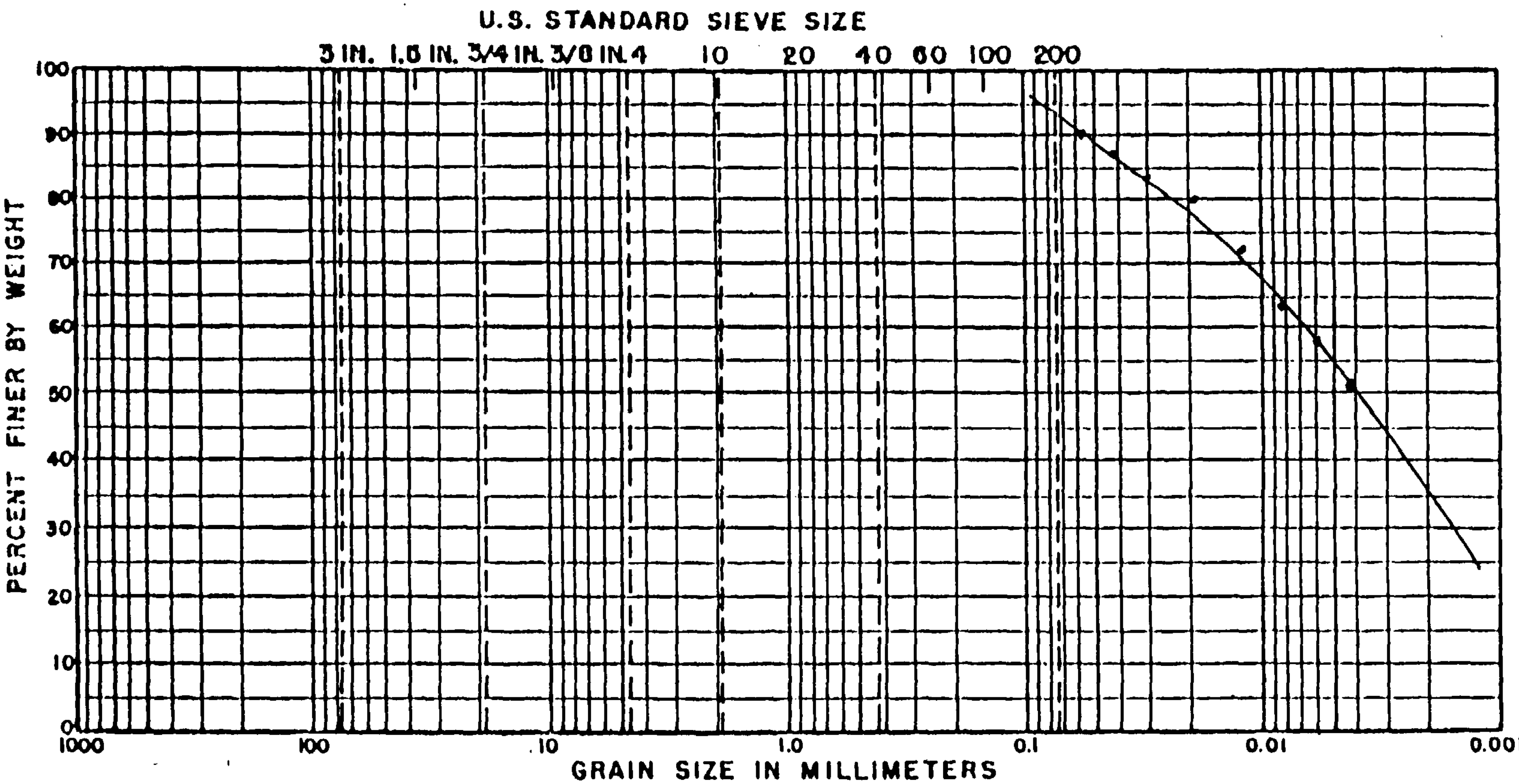
H. H. HOLMES TESTING LABORATORIES, INC.

LAKE Co GRADING CLAY
Abbott



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

GRADATION CURVE

Micro-Fiber Laboratories, Inc.
625 Landwehr Road, Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

HOLMES TESTING LABORATORIES

170 Shepard Avenue
Wheeling, Illinois 60090

Prepared By:

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, Illinois 60062
(708) 498-4127

April 10, 1990

I. PURPOSE

Mr. Jim Bernardi of Holmes Testing Laboratories, engaged Micro-Fiber Laboratories, Inc., to analyze two (2) suspect asbestos bulk soil samples.

II. ANALYTICAL METHOD

The samples were analyzed using polarized light microscopy with EPA recommended central stop dispersion staining.

III. RESULTS

Sample No.	Location	Material
LCG-1		* <1% asbestos; Rock, Soil, 99+%
LCG-2		* <1% asbestos; Cellulose, 2%; Rock, Soil, 97+%

* Denotes non-asbestos containing material.

It is recommended practice that floor tile be analyzed by TEM methods for positive identification of asbestos content. The PLM method may not always be accurate.

(This report can be reproduced in its entirety. This report relates to only the items tested and any conclusions regarding this data, other than those drawn by Micro-Fiber Laboratories, Inc., may not be valid.)

Reviewed:

Robert G. Cooley

Robert G. Cooley
President

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

SAMPLE SOURCE

NAME: HOLMES LABORATORIES
ADDRESS: 170 SHEPARD
WHEELING, IL 60090

COLLECTED BY:
DATE COLLECTED:
DATE RECEIVED: 4-7-90
BY: M.F.L.

COMPOSITION / SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
LCG-1		TAN BROWN	Y	N													99+	ROCK, SOIL
LCG-2		BROWN	Y	N						2							97+	" "

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING. 4-9-90

ANALYST (SIGNATURE) Lawrence Gleason

*DENOTES NOT ASBESTOS CONTAINING MATERIAL

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H. H. HOLMES TESTING LABORATORIES, INC.

Report No. 29

• 170 Shepard Avenue • Wheeling, Illinois 60090 • 708 • 541-4040 • Fax: 708 • 537-9098

April 13, 1990

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

Gentlemen:

Attached is a graph showing the results of the Standard Proctor Test which we made on a sample of Brown Silty Clay which we sampled from the above noted project.

The test results indicate a Maximum Compaction or Optimum Density of 110.3 pounds per cubic foot with a water content of 16.7%.

The sample had a field moisture of 13.6%.

CRA/MANVILLE
WAUKEGAN, IL

APR 17 1990

RECEIVED

Respectfully submitted,

Richard E Nelson Jr/m

Todd R Nelson

Richard E.Nelson, Jr.
President

Todd R.Nelson
Vice President

REN/pbn

Lake Co Grading

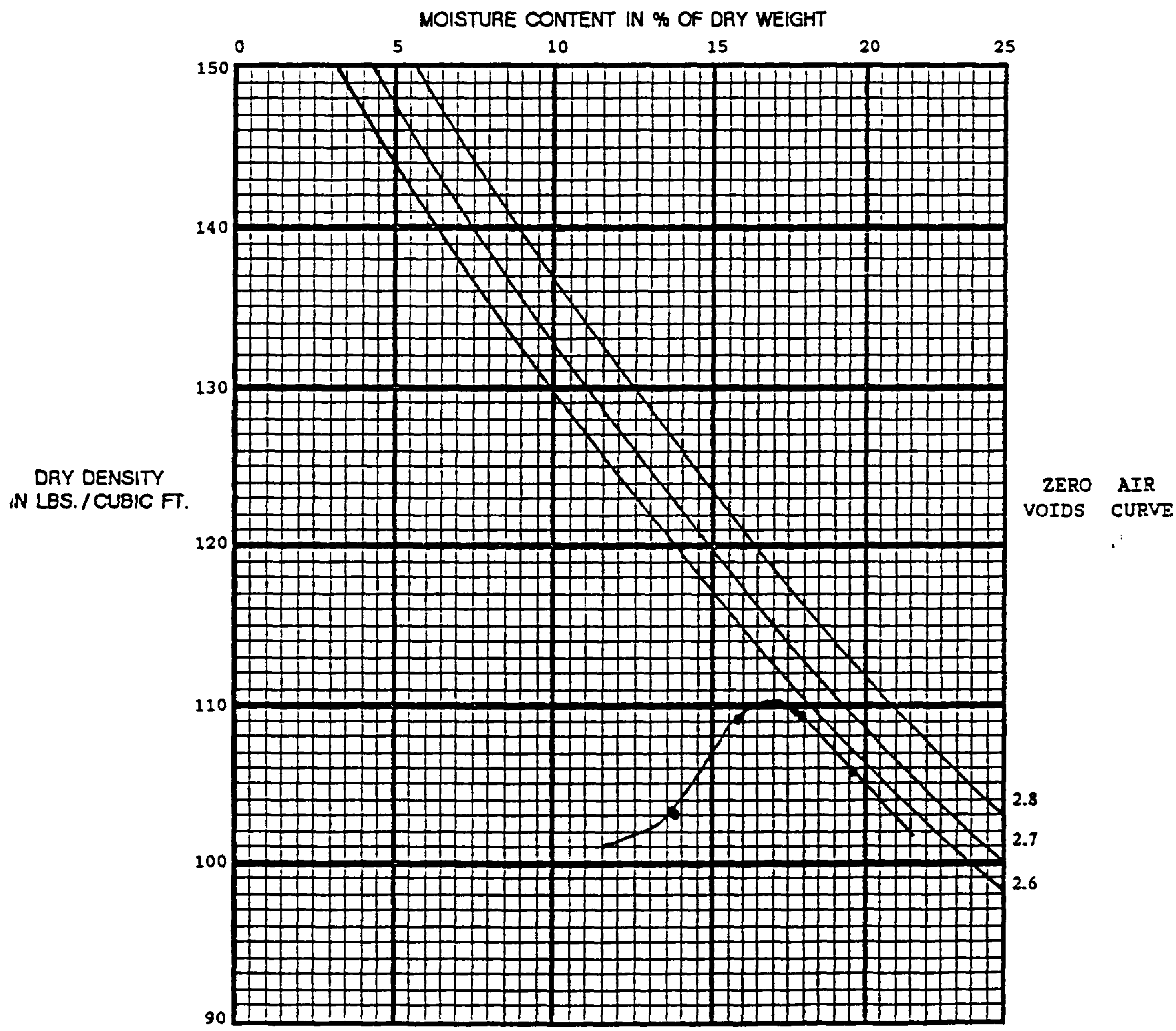
SOIL Brown Silty Clay

LOCATION John Mansville

OPTIMUM MOISTURE CONTENT 16.7%

MAXIMUM DRY DENSITY 110.3#

METHOD OF COMPACTION ASTM D-698



COMPACTION TEST DATA

H. H. HOLMES TESTING LABORATORIES, INC.

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• inspection
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• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 31

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL

AUG 1 3 1990

RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay
Date Received	:	7-9-90
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Lake Michigan Water Supply

TEST DATA

			Specifications
Asbestos	:	Non-Asbestos Containing Material	
pH	:	6.9	
Organic (%)	:	3.6	$\leq$ 10%
Moisture (%)	:	~~13~~ 12.5	
Standard Proctor (lbs/ft^3)	:	~~116.0~~ 115.4	
Optimum Moisture (%)	:	~~13.3~~ 14.3	
Sand (%)	:	8	
Silt (%)	:	44	
Clay (%)	:	48	25-60%
Passing No. 10 Sieve (%) 2.0 mm	:	96	
Liquid Limit (%)	:	31.2	
Plastic Limit (%)	:	19.2	
Plasticity Index (%)	:	12.0	
Classification	:	CL	CL or ML-CL

Respectfully submitted,

Richard E. Nelson Jr/PB

Richard E.Nelson,Jr.
President

Todd R. Nelson

Todd R.Nelson
Laboratory Manager

REN/pbn

Micro-Fiber Laboratories, Inc.
625 Landwehr Road, Northbrook, IL 60062
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1-800-373-LABS
FAX (708) 498-4453

HOLMES TESTING LABORATORIES

170 Shepard Avenue
Wheeling, Illinois 60090

Prepared By:

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, Illinois 60062
(708) 498-4127

July 17, 1990

I. PURPOSE

Mr. Jim Bernardi of Holmes Testing Laboratories, engaged Micro-Fiber Laboratories, Inc., to analyze three (3) suspect asbestos bulk soil samples.

II. ANALYTICAL METHOD

The samples were analyzed using polarized light microscopy with EPA recommended central stop dispersion staining.

III. RESULTS

Sample No.	Location	Material
VHW-1		* <1% asbestos; Cellulose, 2%; Soil, 97+%
LMWS-1		* <1% asbestos; Cellulose, 1%; Soil, 98+%
LMWS-1		* <1% asbestos; Cellulose, 5%; Synthetics, 6%; Soil, Rock, 88+%

* Denotes non-asbestos containing material.

It is recommended practice that floor tile be analyzed by TEM methods for positive identification of asbestos content. The PLM method may not always be accurate.

IV. CONCLUSION

None of the samples analyzed tested positive for Asbestos Containing Material (ACM).

(This report can be reproduced in its entirety. This report relates to only the items tested and any conclusions regarding this data, other than those drawn by Micro-Fiber Laboratories, Inc., may not be valid.)

Reviewed:

Robert G. Cooley

Robert G. Cooley
President

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

SAMPLE SOURCE

NAME: HOLMES TESTING LABS
ADDRESS: 170 SHEPARD AVE.
WHEELING, IL. 60090

COLLECTED BY: Jim Bernardi
DATE COLLECTED:
DATE RECEIVED: 7-9-90
BY: M.F.L.

Project: Lake Michigan Water supply - John Mansville

COMPOSITION / SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
LMWS-2		BROWN	Y	N						5			6				88+	SOIL, ROCK

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING. 7-10-40

ANALYST (SIGNATURE) Lawrence Gleason

*DENOTES NOT ASBESTOS CONTAINING MATERIAL

ANALYST (PRINTED) LAWRENCE GLEASON

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

PAGE 1 OF 1

SAMPLE SOURCE

NAME: HOLMES TESTING LABS
ADDRESS: 170 SHEPARD AVE.
WHEELING, IL. 60090

COLLECTED BY: Jim Bernardi
DATE COLLECTED:
DATE RECEIVED: 7-9-90
BY: M.F.L.

Project: Lake Michigan Water supply - John Mansville

SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
LMWS-1		BROWN	Y	N	—	—	—	—	—	1	—	—	—	—	—	—	98+	SOIL, ROCK

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING. 7-10-90

ANALYST (SIGNATURE) Lawrence [illegible]

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

SAMPLE SOURCE
NAME: HOLMES TESTING LABS
ADDRESS: 170 SHEPHARD AVE.
WHEELING, IL. 60090

COLLECTED BY: Jim Bernardi
DATE COLLECTED:
DATE RECEIVED: 7-9-90
BY: M.F.L.

Project: Victory Hospital - Waukegan, John Manville

COMPOSITION / SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
UHW-1		BROWN	Y	N	—	—	—	—	—	2	—	—	—	—	—	—	97+	SOIL, ROCK

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING. 7-10-90

ANALYST (SIGNATURE) Lawrence [illegible]

H. H. HOLMES TESTING LABORATORIES, INC.

• inspection • evaluation • research

construction materials

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 32

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL

AUG 1 3 1990

RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay
Date Received	:	7-9-90
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Victory Hospital, Waukegan

TEST DATA

			Specifications
Asbestos	:	Non-Asbestos Containing Material	
pH	:	6.8	
Organic (%)	:	4.9	≤ 10%
Moisture (%)	:	~~12.5~~ 12.0	
Standard Proctor (lbs/ft³)	:	~~119.2~~ 116.0	
Optimum Moisture (%)	:	~~14.3~~ 13.3	
Sand (%)	:	16	
Silt (%)	:	41	
Clay (%)	:	43	25-60%
Passing No. 10 Sieve (%) 2.0 mm	:	95	
Liquid Limit (%)	:	27.3	
Plastic Limit (%)	:	16.6	
Plasticity Index (%)	:	10.7	
Classification	:	CL	CL or ML-CL

Respectfully submitted,

Richard E. Nelson

Richard E.Nelson,Jr.
President

Todd R. Nelson

Todd R.Nelson
Laboratory Manager

REN/pbn

H. H. HOLMES TESTING LABORATORIES, INC.

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construction materials

• 170 Shepard Avenue • Wheeling, Illinois 60090 • 708 • 541-4040 • Fax: 708 • 537-9098

Report No. 33

July 20, 1990

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O. Box L
Libertyville, IL 60048

Re: John Manville -
Lake Michigan Water
Supply

Gentlemen:

Attached is a graph showing the results of the Standard Proctor Test which we made on a sample of Brown Silty Clay which we sampled from the above noted project.

The test results indicate a Maximum Compaction or Optimum Density of 116.0 pounds per cubic foot with a water content of 13.3%.

The sample had a field moisture of 12.0%.

CRA/MANVILLE
WAUKEGAN, IL

AUG 1 3 1990

RECEIVED

Respectfully submitted,

Richard E. Nelson pls

Richard E. Nelson, Jr.
President

Scott Nelson

Scott Nelson
Vice President

REN/pls

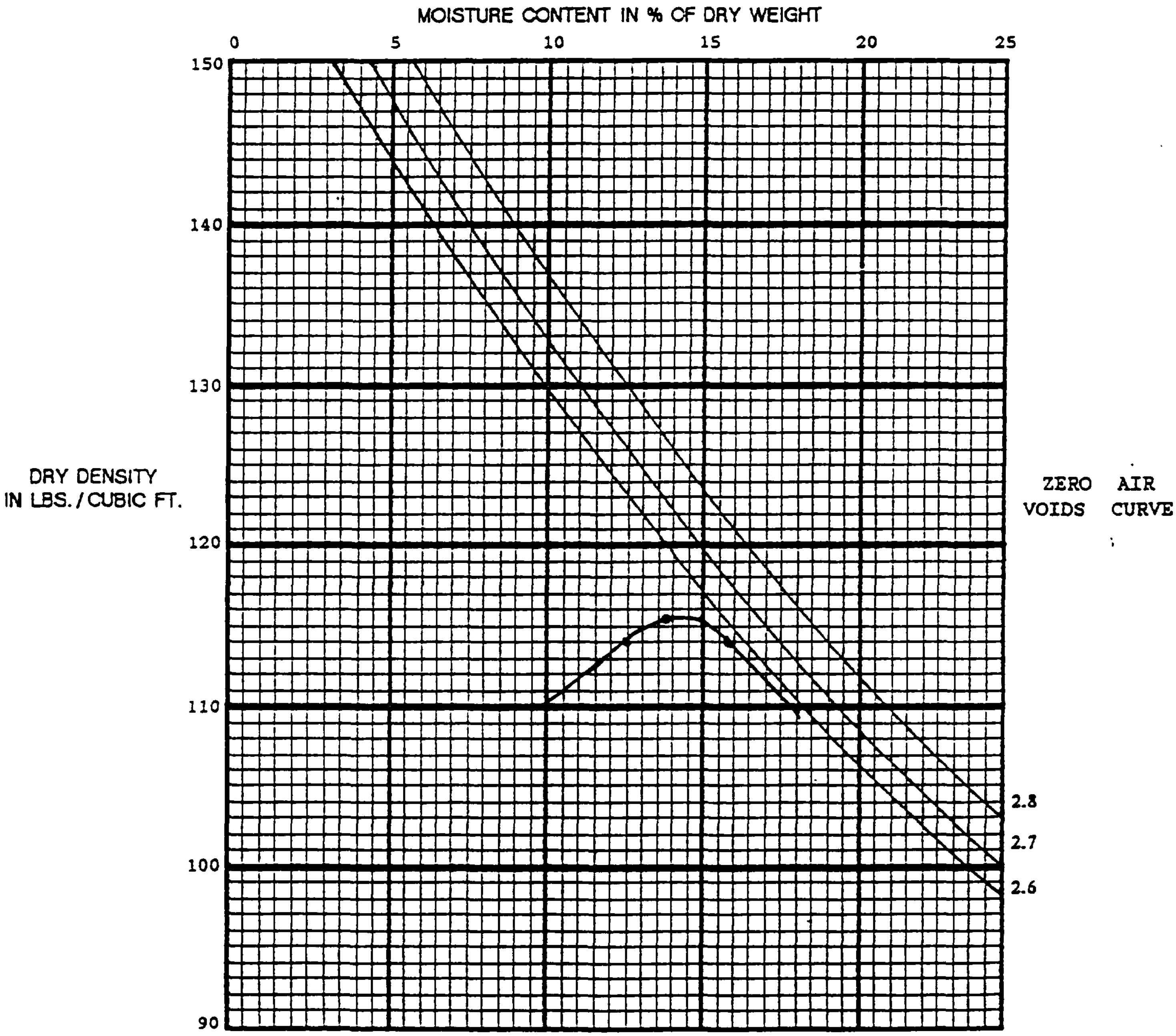
SOIL Br...n Silty Clay

LOCATION Victory Hospital - Waukegan

OPTIMUM MOISTURE CONTENT 14.3%

MAXIMUM DRY DENSITY 115.4#

METHOD OF COMPACTION ASTM D-1557



COMPACTION TEST DATA

H. HOLMES TESTING LABORATORIES, INC.

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rev 11-28-88

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Report No. 34

July 20, 1990

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O. Box L
Libertyville, IL 60048

Re: John Manville -
Victory Hospital -
Waukegan

Gentlemen:

Attached is a graph showing the results of the Modified Proctor Test which we made on a sample of Brown Silty Clay which we sampled from the above noted project.

The test results indicate a Maximum Compaction or Optimum Density of 115.4 pounds per cubic foot with a water content of 14.3%.

The sample had a field moisture of 12.5%.

CRA/MANVILLE
WAUKEGAN, IL

AUG 13 1990

RECEIVED

Respectfully submitted,

Richard E. Nelson Jr/ts

Richard E. Nelson, Jr.
President

Scott Nelson

Scott Nelson
Vice President

REN/pls

Lake County Grading

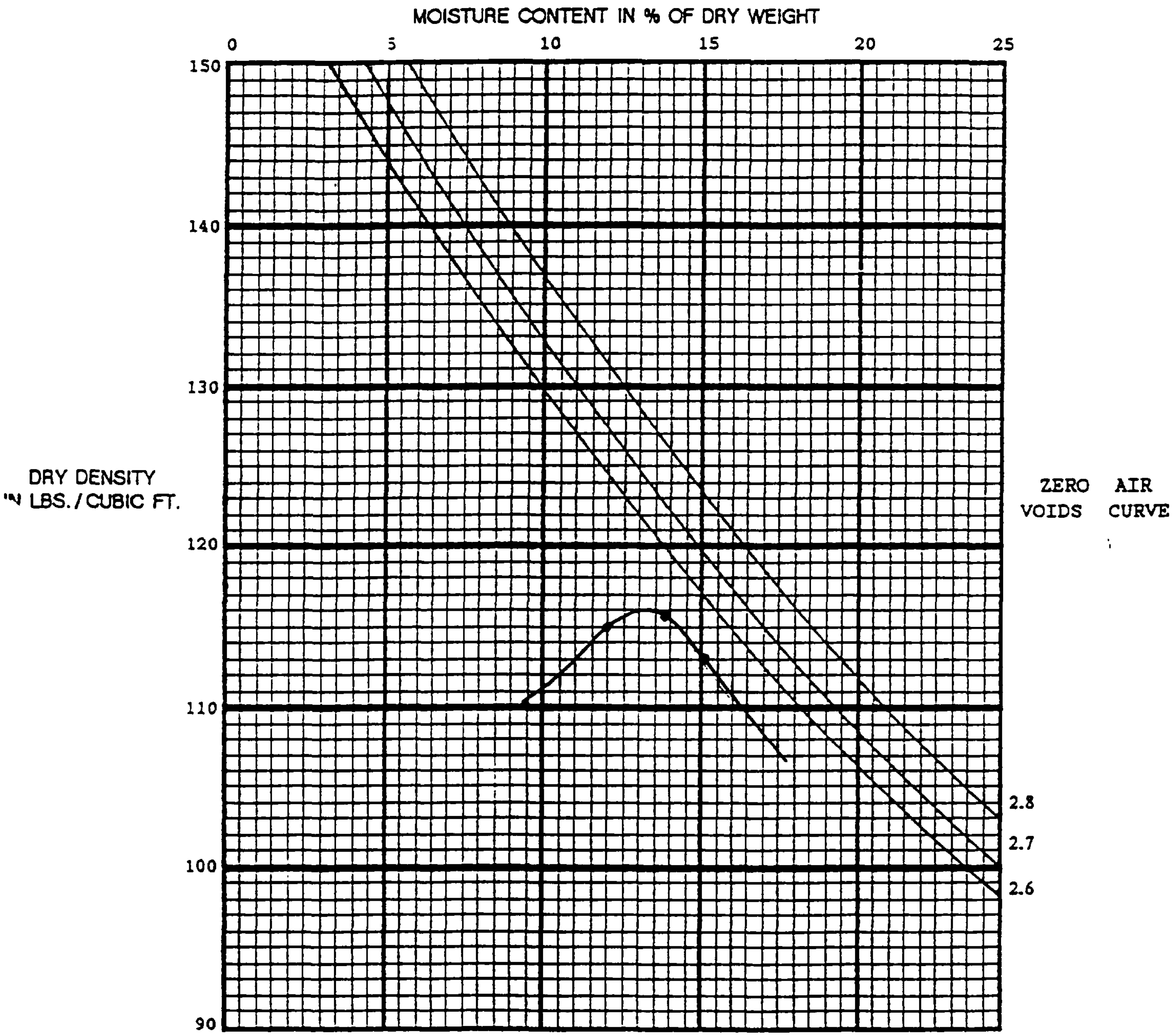
SOIL Brown Silty Clay

LOCATION Lake Michigan Water Supply

OPTIMUM MOISTURE CONTENT 13.3%

MAXIMUM DRY DENSITY 116.0#

METHOD OF COMPACTION ASTM D-1557



COMPACTION TEST DATA

H. H. HOLMES TESTING LABORATORIES, INC.

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H. H. HOLMES TESTING LABORATORIES, INC.

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Report No. 35

October 17, 1990

Lab No. CH 4326
File No. 6556.11

RECEIVED OCT 1 [illegible]

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL
OCT 1 9 1990
RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Brown Silty Clay
Date Received	:	10-2-90
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	Project Specifications
Source of Material	:	Waukegan West High School

TEST DATA

			Specifications
Asbestos	:	Non-asbestos containing material	
pH	:	6.8	
Organic (%)	:	2.0	$\leq$ 10%
Moisture (%)	:	15.1	
Standard Proctor (lbs/ft^3)	:	113.2	
Optimum Moisture (%)	:	13.7	
Sand (%)	:	2	
Silt (%)	:	45	
Clay (%)	:	53	25-60%
Passing No. 10 Sieve (%) 2.0 mm	:	96	
Liquid Limit (%)	:	27	
Plastic Limit (%)	:	14	
Plasticity Index (%)	:	13	
Classification	:	CL	CL or ML-CL

Respectfully submitted,

Richard E.Nelson,Jr.
President

Todd R.Nelson
Vice President

REN/pbn

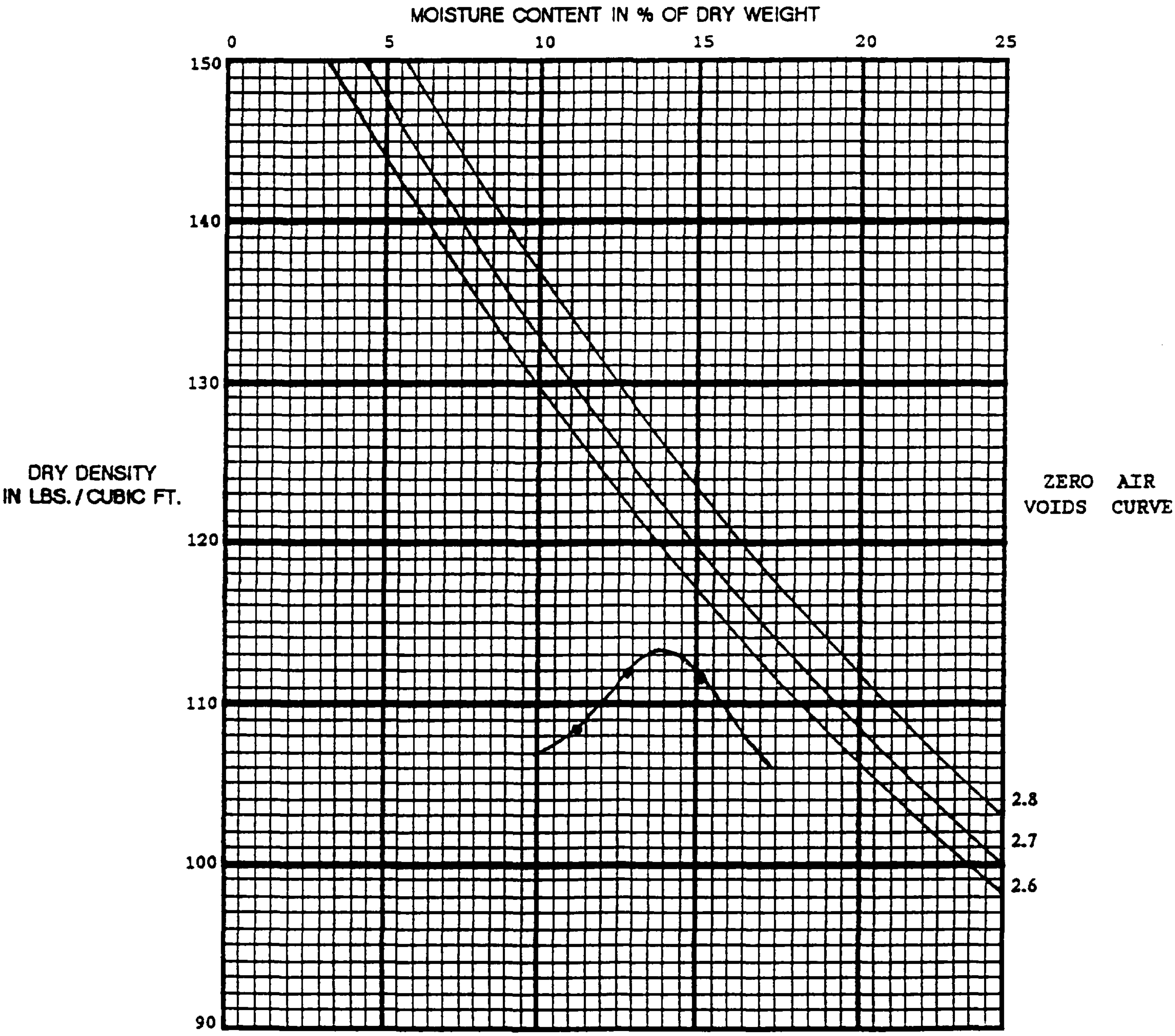
SOIL Brown Silty Clay

LOCATION John Mansville, Waukegan

OPTIMUM MOISTURE CONTENT 13.7%

MAXIMUM DRY DENSITY 113.2

METHOD OF COMPACTION D-698



COMPACTION TEST DATA

H. H. HOLMES TESTING LABORATORIES, INC.

- inspection
- evaluation
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construction materials

rev 11-28-88

Micro-Fiber Laboratories, Inc.
625 Landwehr Road, Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

HOLMES TESTING LABORATORIES

170 Shepard Avenue
Wheeling, Illinois 60090

Prepared By:

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, Illinois 60062
(708) 498-4127

October 5, 1990

I. PURPOSE

Mr. Jim Bernardi of Holmes Testing Laboratories, engaged Micro-Fiber Laboratories, Inc., to analyze one (1) suspect asbestos bulk soil sample obtained from project 2968.

II. ANALYTICAL METHOD

The sample was analyzed using polarized light microscopy with EPA recommended central stop dispersion staining.

III. RESULTS

Sample No.	Location	Material
2968		* <1% asbestos; Cellulose, 2%; Soil, Rock, 97+%

* Denotes non-asbestos containing material.

It is recommended practice that floor tile be analyzed by TEM methods for positive identification of asbestos content. The PLM method may not always be accurate.

(This report can be reproduced in its entirety. This report relates to only the items tested and any conclusions regarding this data, other than those drawn by Micro-Fiber Laboratories, Inc., may not be valid.)

Reviewed:

Robert G. Cooley

Robert G. Cooley
President

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

SAMPLE SOURCE

NAME: HOLMES TESTING LABORATORIES
ADDRESS: 170 SHEPARD AVE.
WHEELING, IL 60090

W.W. HIGH SCHOOL

COLLECTED BY:
DATE COLLECTED:
DATE RECEIVED: 10-3-90
BY: M.F.L.

COMPOSITION / SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
2968		BROWN	Y	N	—	—	—	—	—	2	—	—	—	—	—	—	97+	SOIL, ROCK

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING. 10-5-90

ANALYST (SIGNATURE) Lawrence Gleason
ANALYST (PRINTED) LAWRENCE GLEASON

APPENDIX A-3

TOPSOIL

WAUKEGAN IL

JUN 22 1989

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Rec'd CRA

JUN 21 1989

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- research

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H. H. HOLMES TESTING LABORATORIES, INC.

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 7

April 27, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Black Topsoil
Date Received	:	4-17-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	IDOT Article 717.04
Source of Material	:	Deer Valley/Woodfield Estates

TEST DATA

			Specifications
Asbestos	:	Not Detected	
pH	:	6.4	5-8
Organic *(%)	:	8.5	1-10%
Moisture (%)	:	28.0	
Standard Proctor (lbs/ft^3)	:	102.2	
Optimum Moisture (%)	:	19.8	
Sand (%)	:	5	<55
Silt (%)	:	50	
Clay (%)	:	45	12% Min. 50% Max.
Passing No. 10 Sieve (%)	:	95	90%

*Sample contained some roots, which were removed before testing.

Respectfully submitted,

Richard E.Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

H. H. HOLMES TESTING LABORATORIES, INC.

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• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 13

July 1, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL

JUL 6 1989

RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Topsoil
Date Received	:	6-27-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	IDOT Article 717.04
Source of Material	:	Washington and Hyundoi

TEST DATA

			Specifications
Asbestos	:	None Detected	
pH	:	6.6	5-8
Organic (%)	:	5.7	~~≤10%~~ 1-10%
Moisture (%)	:	22.6	
Sand (%)	:	19	≤ 55%
Silt (%)	:	56	
Clay (%)	:	25	~~25-60%~~ 12-50%
Passing No. 10 Sieve (%)	:	90	≥ 90%
Liquid Limit (%)	:	36	
Plastic Limit (%)	:	22	
Plasticity Index(%)	:	14	
Classification	:	CL	~~CL or ML-CL~~

Respectfully submitted,

Richard E. Nelson, Jr. /fu

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

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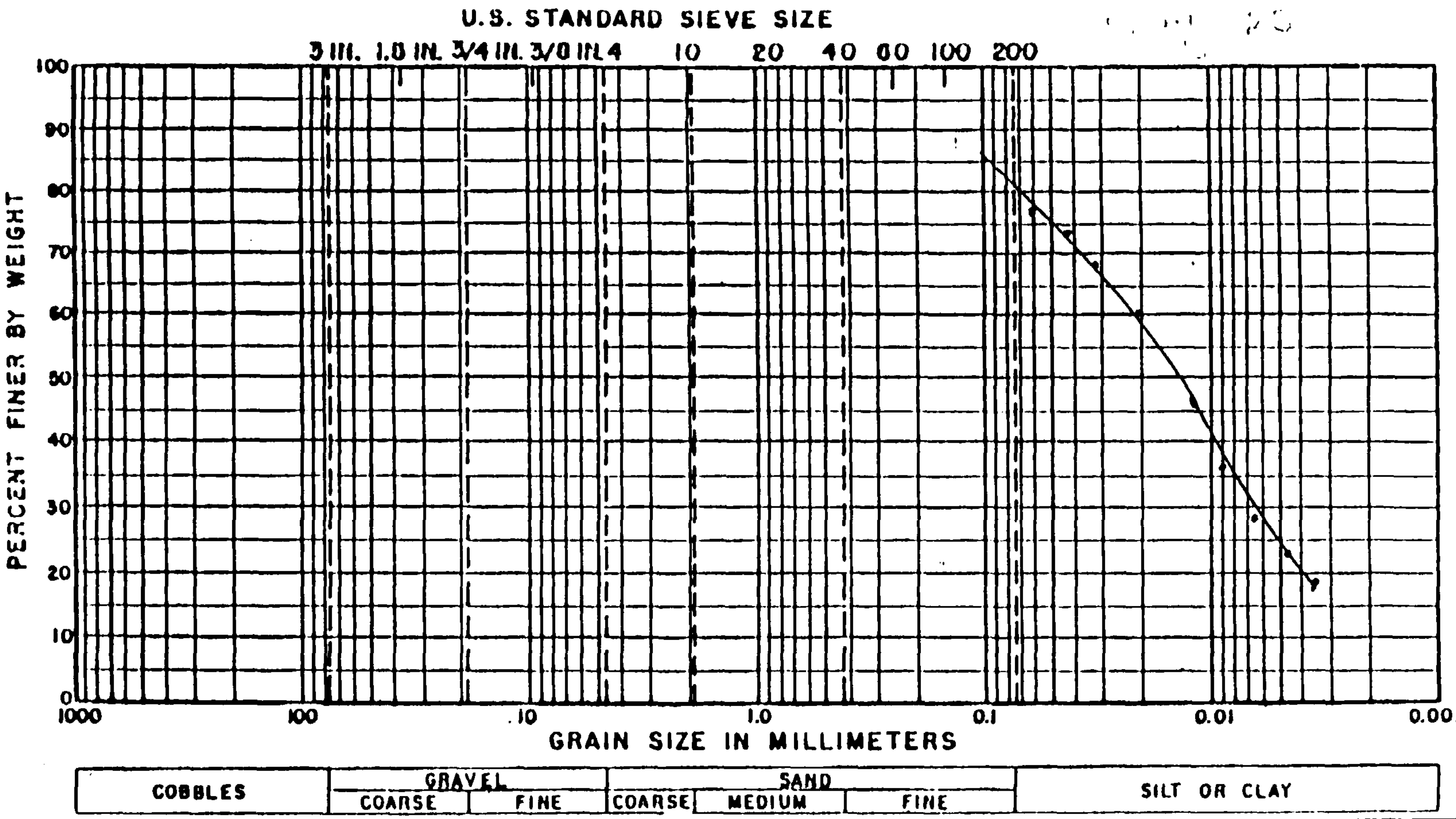
H. H. HOLMES TESTING LABORATORIES, INC.



	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

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H. H. HOLMES TESTING LABORATORIES, INC.

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 15

July 10, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O. Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, Il

CRA/MANVILLE
WAUKEGAN, IL

JUL 11 1989

RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Black Top soil
Date Received	:	7-3-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	IDOT Article 717.04
Source of Material	:	Grand Tri-State

TEST DATA

			Specifications
Asbestos	:	None Detected	
pH	:	6.7	5-8
Organic (%)	:	6.4	~~≤10%~~ 1-10%
Moisture (%)	:	19.3	
Sand (%)	:	24	≤ 55%
Silt (%)	:	42	
Clay (%)	:	34	~~25-60%~~ 12% – 50%
Passing #10 Sieve (%)	:	95	≥ 90%
Liquid Limit (%)	:	37	
Plastic Limit (%)	:	24	
Plasticity Index (%)	:	13	~~CL or ML-CL~~
Classification	:	CL	

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pls

H. H. HOLMES TESTING LABORATORIES, INC.

inspection • evaluation • research

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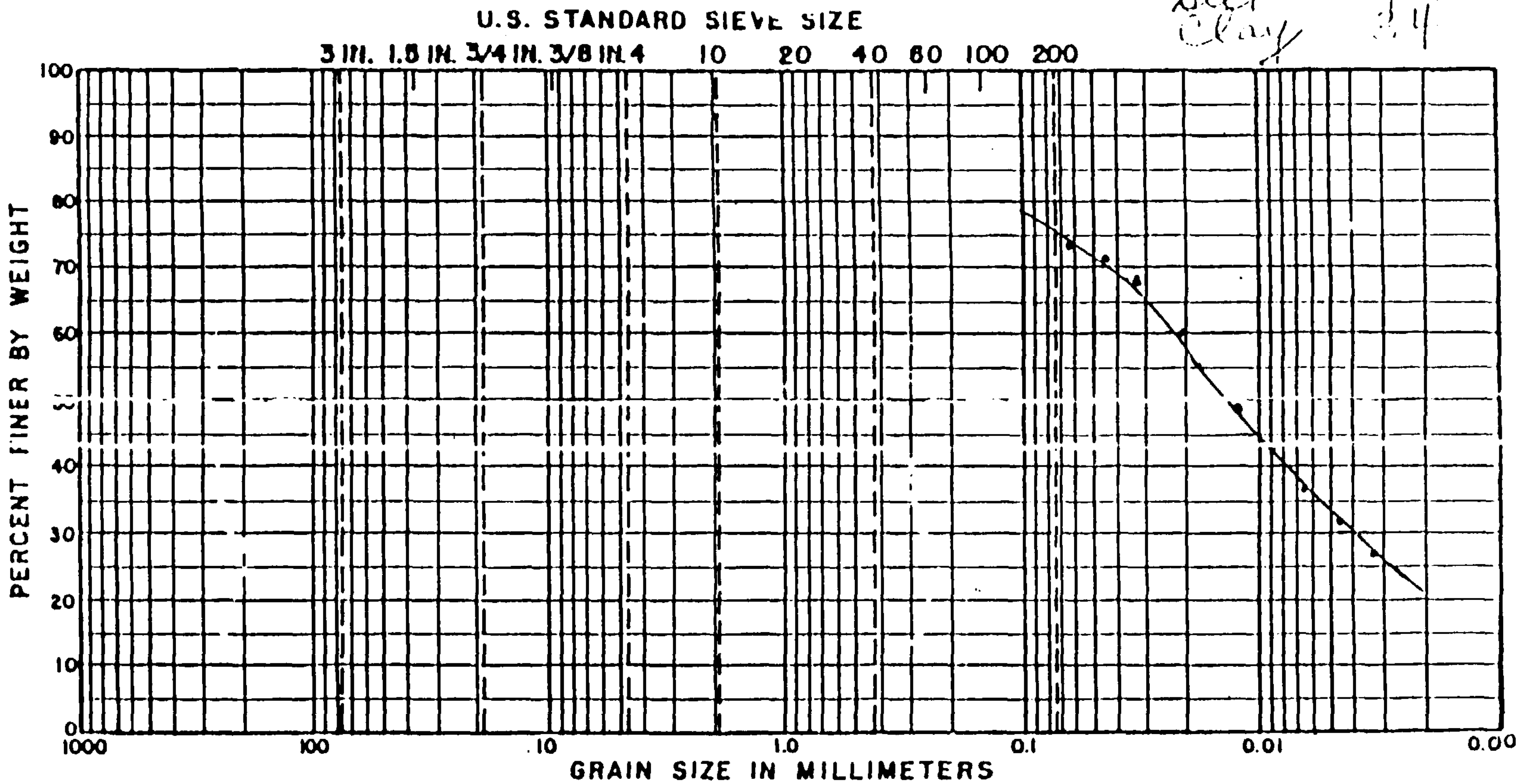
Sand [illegible]
Silt [illegible]
Clay [illegible]



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

Grand Tri-State

GRADATION CURVE

H. H. HOLMES TESTING LABORATORIES, INC.

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• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 14

July 1, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL

JUL 6 1989

RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Black Topsoil
Date Received	:	6-27-89
Method of Test	:	ASTM C-40, D-698, C-51, C-422
Specifications	:	IDOT Article 717.04
Source of Material	:	Washington and Rte. 21

TEST DATA

			Specifications
Asbestos	:	None Detected	
pH	:	6.7	5-8
Organic (%)	:	7.1	~~≤10%~~ 1-10%
Moisture (%)	:	25.3	
Sand (%)	:	17	≤ 55%
Silt (%)	:	58	
Clay (%)	:	25	~~25-60%~~ 12-50%
Passing No. 10 Sieve (%)	:	93	≥ 90%
Liquid Limit (%)	:	36	
Plastic Limit (%)	:	22	
Plasticity Index(%)	:	14	
Classification	:	CL	~~CL or ML-CL~~

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

H. H. HOLMES TESTING LABORATORIES, INC.

•ins[illegible]tion
•ev[illegible]tion
•research

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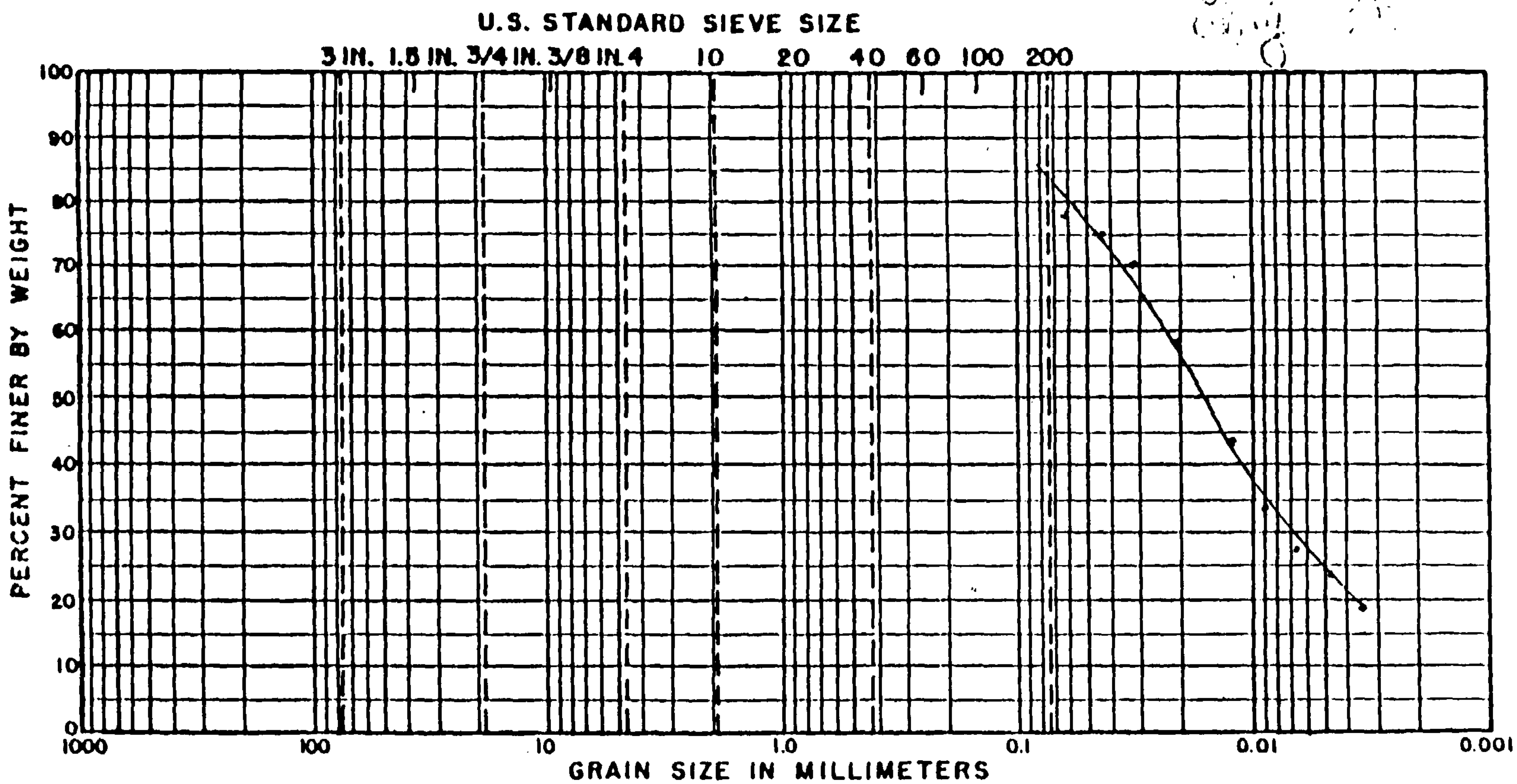

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

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H. H. HOLMES TESTING LABORATORIES, INC.

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 17

July 13, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL

JUL 17 1989

RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Black Topsoil
Date Received	:	7-7-89
Method of Test	:	ASTM C-40, C-51, C-422
Specifications	:	IDOT Article 717.04
Source of Material	:	Grandview

TEST DATA

			Specifications
Asbestos	:	None Detected	
pH	:	6.5	5-8
Organic (%)	:	4.5	1-10%
Moisture (%)	:	21.5	
Sand (%)	:	24	∠ 55
Silt (%)	:	51	
Clay (%)	:	25	12-50%
Passing No. 10 Sieve (%) (2.0 mm)	:	94	90% Minimum
Liquid Limit (%)	:	35	
Plastic Limit (%)	:	24	
Plasticity Index(%)	:	11	
Classification	:	CL	

Respectfully submitted,

Richard E. Nelson Jr./r/n

Richard E. Nelson, Jr.
President

Todd R. Nelson
Laboratory Manager

REN/pbn

H. H. HOLMES TESTING LABORATORIES, INC.

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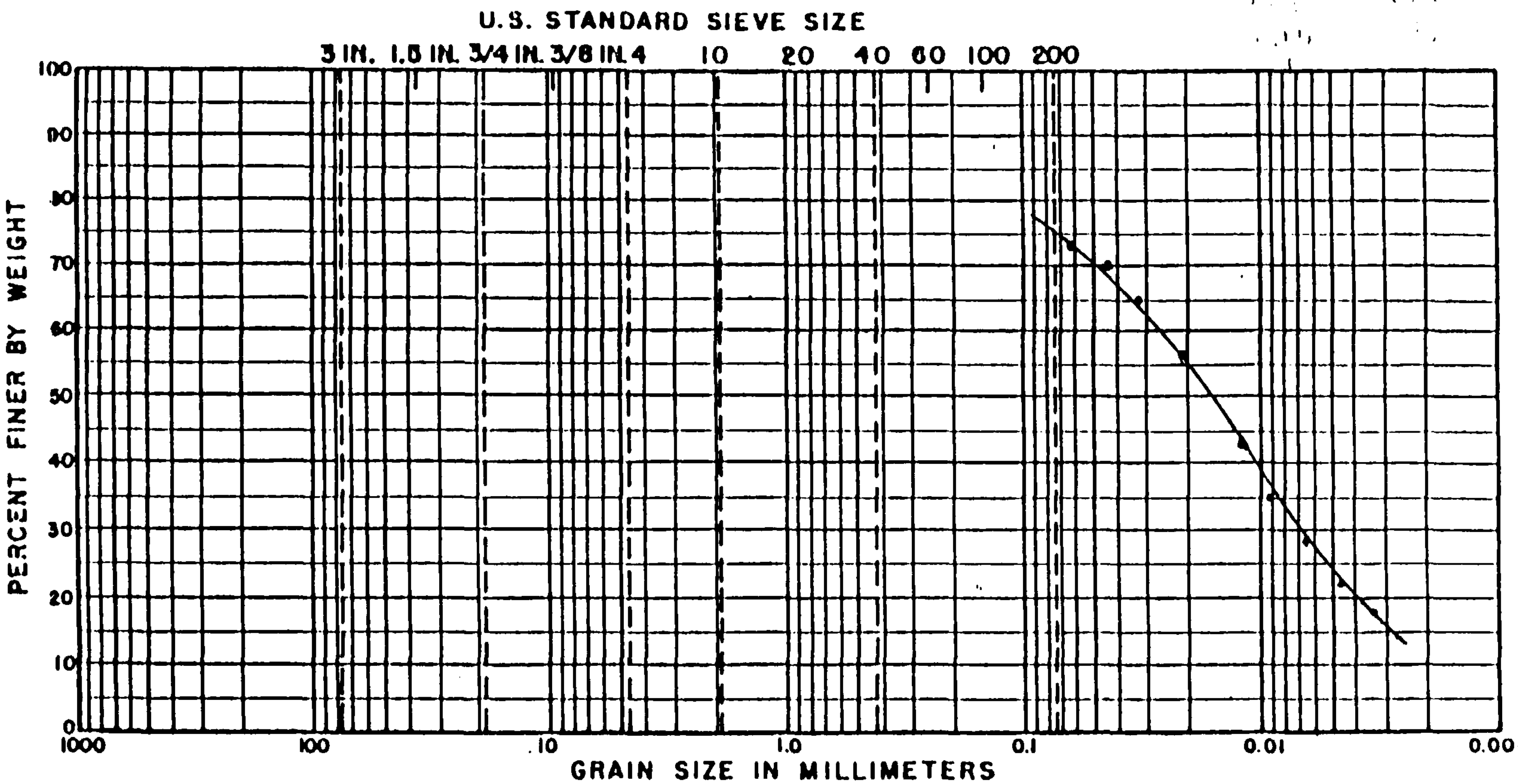
- evaluation
- research

construction materials



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

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H. H. HOLMES TESTING LABORATORIES, INC.

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 22

October 4, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O. Box L
Libertyville, Illinois 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL
OCT 7 1989
RECEIVED

REPORT OF TESTS

Subject	: Analysis of Soil
Material	: Black Topsoil
Date Received	: 9-21-89
Method of Test	: ASTM C-40, C-51, C-422
Specifications	: IDOT Article 717.04
Source of Material	: Skokie Lagoon

TEST DATA

		Specifications
Asbestos	<1%*	
pH	6.7	5-8
Organic (%)	9.0	1-10%
Moisture (%)	22.5	
Sand (%)	26	<55
Silt (%)	48	
Clay (%)	26	12-50%
Passing No. 10 Sieve (%) 2.0 mm	95	90 Minimum
Liquid Limit (%)	44.6	
Plastic Limit (%)	29.5	
Plasticity Index (%)	15.1	
Classification	ML	

*See Enclosure

Respectfully submitted,

Richard E. Nelson, Jr. /M

Richard E. Nelson, Jr.
President

Todd R. Nelson

Todd R. Nelson
Laboratory Manager

REN/bal

LC GRADING S E LAGOON

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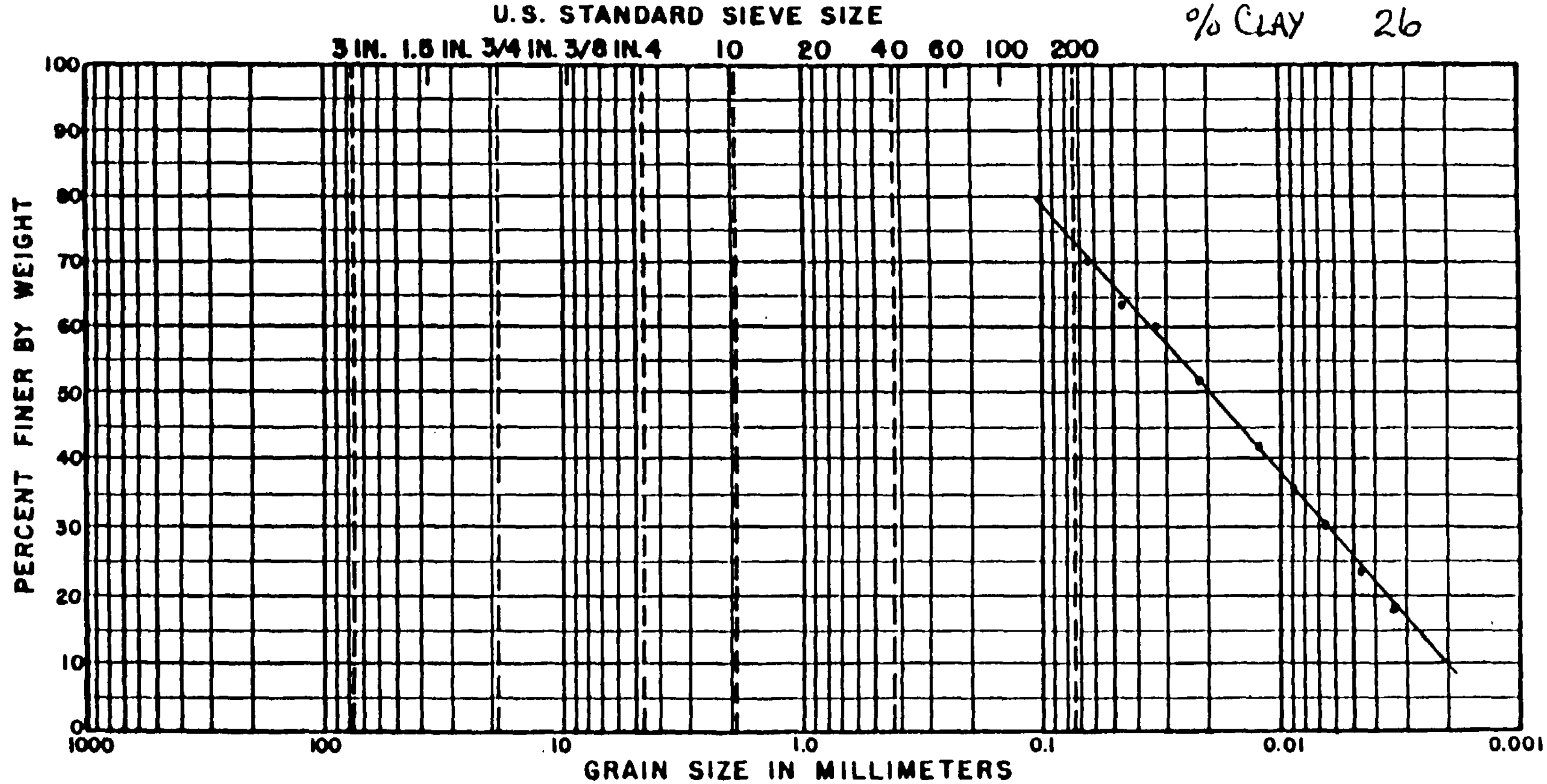
H. H. HOLMES TESTING LABORATORIES, INC.

% SAND 26
% SILT 48
% CLAY 26



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION	NAT. WC	LL	PL	PI	

GRADATION CURVE

Micro-Fiber Laboratories, Inc.
625 Landwehr Road, Northbrook, IL 60062
(312) 498-4127
1-800-82-MICRO (312 Area Code)
1-800-373-LABS (Outside 312 Area Code)
FAX (312) 498-4453

HOLMES TESTING LABORATORIES

170 Shepard Avenue
Wheeling, Illinois 60091

Prepared By:

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, Illinois 60062
(312) 498-4127

September 28, 1989

I. PURPOSE

Mr. Jim Bernardi of Holmes Testing Laboratories, engaged Micro-Fiber Laboratories, Inc., to analyze one (1) suspect asbestos bulk soil sample.

II. ANALYTICAL METHOD

The sample was analyzed using polarized light microscopy with EPA recommended central stop dispersion staining.

III. RESULTS

Sample No.	Location	Material
2285		* <1% asbestos; Cellulose, 5%; Soil, Rock, 94+%

* Denotes non-asbestos containing material.

It is recommended practice that floor tile be analyzed by TEM methods for positive identification of asbestos content. The PLM method may not always be accurate.

(This report can be reproduced in its entirety. This report relates to only the items tested and any conclusions regarding this data, other than those drawn by Micro-Fiber Laboratories, Inc., may not be valid.)

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

SAMPLE SOURCE

NAME: HOLMES TESTING LABS
ADDRESS: 170 SHEPARD AVE.
WHEELING, IL 60091

COLLECTED BY:
DATE COLLECTED:
DATE RECEIVED: 9-22-89
BY: M.F.L.

COMPOSITION / SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
2285		Brown	Y	N	—	—	—	—	—	5	—	—	—	—	—	—	94+	Soil, Rock

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING.

ANALYST (SIGNATURE) Lawrence [illegible] 9-28-89

inspection
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H. H. HOLMES TESTING LABORATORIES, INC.

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 23

October 13, 1989

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL

OCT 18 1989

RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Black Topsoil
Date Received	:	10-2-89
Method of Test	:	ASTM C-40, C-51, C-422
Specifications	:	IDOT Article 717.04
Source of Material	:	Sunset and Delany Roads

TEST DATA

			Specifications
Asbestos	:	Non-Asbestos Containing Material	
pH	:	6.7	5-8
Organic (%)	:	7.9	1-10%
Moisture (%)	:	17.6	
Sand (%)	:	21	<55
Silt (%)	:	41	
Clay (%)	:	38	12-50%
Passing No. 10 Sieve (%) (2.0 mm)	:	97.0	90 Minimum
Liquid Limit (%)	:	41.7	
Plastic Limit (%)	:	25.2	
Plasticity Index(%)	:	16.5	
Classification	:	CL	

Respectfully submitted,

Richard E. Nelson, Jr.
President

Todd R. Nelson
Vice President

REN/pbn

Micro-Fiber Laboratories, Inc.
625 Landwehr Road, Northbrook, IL 60062
(312) 498-4127
1-800-82-MICRO (312 Area Code)
1-800-373-LABS (Outside 312 Area Code)
FAX (312) 498-4453

HOLMES TESTING LABORATORIES

170 Shepard Avenue
Wheeling, Illinois 60090

Prepared By:

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, Illinois 60062
(312) 498-4127

October 6, 1989

I. PURPOSE

Mr. Jim Bernardi of Holmes Testing Laboratories, engaged Micro-Fiber Laboratories, Inc., to analyze one (1) suspect asbestos bulk soil sample.

II. ANALYTICAL METHOD

The sample was analyzed using polarized light microscopy with EPA recommended central stop dispersion staining.

III. RESULTS

Sample No.	Location	Material
2309	Sunset & Delany	* <1% asbestos; Cellulose, 10%; Soil, 89+%

* Denotes non-asbestos containing material.

It is recommended practice that floor tile be analyzed by TEM methods for positive identification of asbestos content. The PLM method may not always be accurate.

(This report can be reproduced in its entirety. This report relates to only the items tested and any conclusions regarding this data, other than those drawn by Micro-Fiber Laboratories, Inc., may not be valid.)

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

ASBESTOS BULK ANALYSIS

PAGE 1 OF 1

SAMPLE SOURCE

NAME: HOLMES

ADDRESS:

COLLECTED BY:

DATE COLLECTED:

DATE RECEIVED: 10-3-89

BY: M.F.L.

COMPOSITION / SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
2309	TOP SOIL SUNSET & DELANY	BROWN	Y	N						10							89+	SOIL

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING.

ANALYST (SIGNATURE) Lawrence Slaw 10-4-8

• inspection
• evaluation
• research
construction materials

H. H. HOLMES TESTING LABORATORIES, INC.

Report No. 28

• 170 Shepard Avenue • Wheeling, Illinois 60090 • 708 • 541-4040 • Fax: 708 • 537-9098

April 13, 1990

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville - Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL
APR 17 1990
RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Black Topsoil (#1)
Date Received	:	4-6-90
Method of Test	:	ASTM C-40,C-51, C-422
Specifications	:	IDOT Article 717.04
Source of Material	:	Abbott

TEST DATA

			Specifications
Asbestos	:	Non-Asbestos Containing Material	
pH	:	6.8	5-8
Organic (%)	:	3.3	1-10%
Moisture (%)	:	24.5	
Sand (%)	:	6	< 55
Silt (%)	:	44	
Clay (%)	:	50	12-50%
Passing No. 10	:		
Sieve (%) (2.0 mm)	:	98	90 Minimum
Liquid Limit (%)	:	41	
Plastic Limit (%)	:	27	
Plasticity Index(%)	:	14	
Classification	:	CL	

Respectfully submitted,

Richard E. Nelson, Jr./pbn

Richard E. Nelson, Jr.
President

Todd R. Nelson

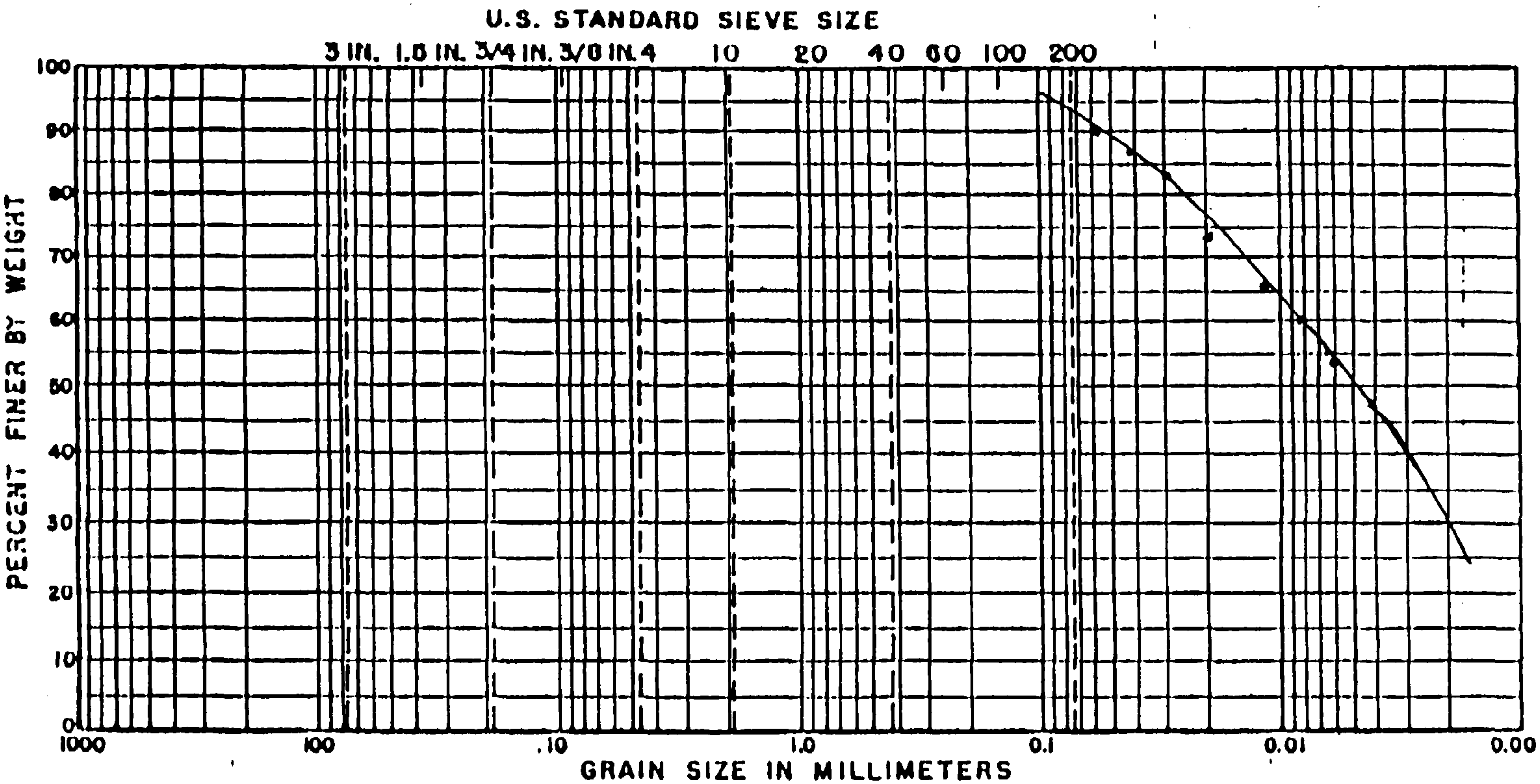
Todd R. Nelson
Vice President

REN/pbn

H. H. HOLMES TESTING LABORATORIES, INC.

inspection
evaluation
research
construction materials

LAKE Co GRADING TOPSOIL
Abbott



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	

GRADATION CURVE

Micro-Fiber Laboratories, Inc.
625 Landwehr Road, Northbrook, IL 60062
(708) 498-4127
1-800-373-LABS
FAX (708) 498-4453

HOLMES TESTING LABORATORIES

170 Shepard Avenue
Wheeling, Illinois 60090

Prepared By:

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, Illinois 60062
(708) 498-4127

April 10, 1990

I. PURPOSE

Mr. Jim Bernardi of Holmes Testing Laboratories, engaged Micro-Fiber Laboratories, Inc., to analyze two (2) suspect asbestos bulk soil samples.

II. ANALYTICAL METHOD

The samples were analyzed using polarized light microscopy with EPA recommended central stop dispersion staining.

III. RESULTS

Sample No.	Location	Material
LCG-1		* <1% asbestos; Rock, Soil, 99+%
LCG-2		* <1% asbestos; Cellulose, 2%; Rock, Soil, 97+%

* Denotes non-asbestos containing material.

It is recommended practice that floor tile be analyzed by TEM methods for positive identification of asbestos content. The PLM method may not always be accurate.

(This report can be reproduced in its entirety. This report relates to only the items tested and any conclusions regarding this data, other than those drawn by Micro-Fiber Laboratories, Inc., may not be valid.)

Reviewed:

Robert G. Cooley

Robert G. Cooley
President

Micro-Fiber Laboratories, Inc.
625 Landwehr Road
Northbrook, IL 60062
(708) 498 4127
1 800 373 LABS
FAX (708) 498 4453

ASBESTOS BULK ANALYSIS

SAMPLE SOURCE

NAME: HOLMES LABORATORIES
ADDRESS: 170 SHEPARD
WHEELING, IL 60090

COLLECTED BY:
DATE COLLECTED:
DATE RECEIVED: 4-7-90
BY: M.F.L.

COMPOSITION / SAMPLE NUMBER	LOCATION	COLOR	HOMOGENEOUS	ASBESTOS PRESENT	ASBESTOS %: CHRYSOTILE	AMOSITE	CROCIDOLITE	ANTHOPHYLLITE	ACTINOLITE TREMOLITE	NON-ASBESTOS %: CELLULOSE	MINERAL WOOL	FIBERGLASS	SYNTHETICS	MICA	PERLITE/PUMICE	BINDER	OTHER	COMMENTS
LCG-1		TAN BROWN	Y	N													99+	ROCK, SOIL
LCG-2		BROWN	Y	N						2							97+	" "

ALL SAMPLES ANALYZED BY POLARIZED LIGHT MICROSCOPY/DISPERSION STAINING. 4-9-90

ANALYST (SIGNATURE) Lawrence Gleason

• inspection
• evaluation
• research

construction materials

H. H. HOLMES TESTING LABORATORIES, INC.

• 170 Shepard Avenue • Wheeling, Illinois 60090 • Area Code 312 • 541-4040

Report No. 30

Lab No. CH 4326
File No. 6556.11

Lake County Grading
P.O.Box L
Libertyville, IL 60048

Re: John Mansville
Waukegan, IL

CRA/MANVILLE
WAUKEGAN, IL

AUG 1 3 1990

RECEIVED

REPORT OF TESTS

Subject	:	Analysis of Soil
Material	:	Black Topsoil
Date Received	:	7-9-90
Method of Test	:	ASTM C-40, C-51, C-422
Specifications	:	IDOT Article 717.04
Source of Material	:	Lake Michigan Water Supply

TEST DATA

			Specifications
Asbestos	:	Non-Asbestos-Containing Material	
pH	:	6.7	5-8
Organic (%)	:	7.2	1-10%
Moisture (%)	:	18	
Sand (%)	:	26	< 55
Silt (%)	:	39	
Clay (%)	:	35	12-50%
Passing No. 10 Sieve(%) 2.0 mm	:	95	90 Minimum
Liquid Limit (%)	:	37.2	
Plastic Limit (%)	:	23.6	
Plasticity Index (%)	:	13.6	
Classification	:	CL	

Respectfully submitted,

Richard E. Nelson

Todd R. Nelson

Richard E. Nelson, Jr.
President

Todd R.Nelson
Laboratory Manager

REN/pbn

APPENDIX B

O'BRIEN SOIL TEST DATA

APPENDIX B-1

ASBESTOS

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: O'Brien & Associates — Date: August 7, 1989

PDL Project: 15585 — Analyst: Ron Sturm

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*----- Cellulose	Fibrous Glass	Other Fibers	
7475 B	Rte. 137 & Sheridan Rd. Pond Area Clay - Brown	<1**	1	<1	Hair/<1	***
7476 B	Rte. 137 & Sheridan Road Pond Area Clay-Gray	<1**	1	<1	Hair/<1	***
7477 B	7/18/89 Pembrook clay	<1**	1-3	<1	--	***
7478 B	Fort Sheridan Clay Stockpile, Barge	<1**	1	<1	--	***
7479 B	89293 - Grand - Tri-State	<1**	1	<1	--	***

*** Predominant Components of Above Soils are Mixed Grains of Carbonates Silicates & Clays. Amphibole is Present as Cleavage Fragments & Grains, But Fibrous Forms are not Detected.

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: O'Brien & Associates

Date: 8/10/89

PDL Project: 15604

Analyst: Ron Sturm

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*----- Cellulose	Fibrous Glass	Other Fibers
7594 B	Grandview (topsoil)	< 1 **	1-3	< 1	Hair/ < 1 ***
7595 B	Grand - Tri-State (topsoil)	< 1 **	3-5	< 1	-- ***

*** = Predominant components of above soils are mixed grains of carbonates, silicates and clays. Amphiboles are present as cleavage fragments and grains, however, fibrous forms are not detected.

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: O'Brien & Associates

Date: August 17, 1989

PDL Project: 15642

Analyst: Ron Sturm

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*-----		
			Cellulose	Fibrous Glass	Other Fibers
7735 B	Stockpile - West of Fence (Tan-Colored Homogeneous Sand)	<1**	<1	<1	<1[a]

a = Predominant Components of the Above Sample are Mixed Sand Grains of Silicates, Carbonates and Opaques. Amphiboles are Present as Cleavage Fragments and Grains, but Fibrous Forms are not Detected.

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.

CRA/MANVILLE
WAUKEGAN, IL

OCT 25 1989

RECEIVED

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: O'Brien & Associates, Inc. Date: 10-6-89

PDL Project: 15791 Analyst: Robert Dal Santo

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*----- Cellulose	Fibrous Glass	Other Fibers
9004-B	Skokie Lagoon Pulverized (TOPSOIL)	Antigorite/<1[b]	1-3	<1	Hair/<1[a]
9005-B	Delaney & Sunset (TOPSOIL)	<1**	1-3	<1	Hair/<1[a]

a = Predominant components of the sample are mixed silicates, carbonates & clays. Amphiboles are present as cleavage fragments and grains but fibrous forms are not detected.

b = Antigorite is a species of the serpentine group and is found to be asbestos form and plated. Also, is similar to chrysotile in both structure & chemistry and often found together.

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: O'Brien & Associates, Inc. Date: 11-20-89

PDL Project: 15937 Analyst: Ron Sturm

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*----- Cellulose	Fibrous Glass	Other Fibers
9954-B	Brown Soil Hawthorn Court (CLAY)	<1**	1	<1	<1[a]

a = Predominantly composed of mixed silicates, carbonates & clays. Amphiboles are present as cleavage fragments and grains. However, fibrous forms are not detected.

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: O'Brien & Associates | Date: 2/23/90

PDL Project: 15791 | Analyst: R.D. Sturm

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*----- Cellulose	Fibrous Glass	Other Fibers
11809-B	#89293 CA-6	<1**	<1	<1	<1 c

c = Soil is Primarily Composed of Carbonate Sands, Silts, & Gravel.

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.

PARTICLE DATA LABORATORIES, LTD.

TAPE SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: O'Brien & Associates   Date: 8/16/90

PDL Project: 16638   Analyst: Kirsten Bolda

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*----- Cellulose	Fibrous Glass	Other Fibers
15213-B	#1 smith stockpile composite clay	Trace-1**	Trace-1	--	--
15215-B	#2 Topsoil L. M. water supply stockpile - central	Trace-1**	-- N O N	-- F I B R O U S	--
15216-B	#3 north stockpile L. Michigan water supply clay stock.	Trace-1**	1-3	--	--

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: O'Brien & Associates   Date: October 12, 1990

PDL Project: 16760   Analyst: John Aschbacher

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*----- Cellulose	Fibrous Glass	Other Fibers
16124-B	Bethesda Village TOPSOIL	TR-1**	3-5	--	--
16125-B	Waukegan West CLAY	TR-1**	1-3	--	--

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT

PARTICLE DATA LABORATORIES, LTD.

CLIENT: O'Brian & Associates, Inc.

PDL PROJECT 17155

PDL LOG NUMBER	SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	ASBESTOS-FORM MATERIAL (%) CHRYSOTILE	AMOSITE	OTHER	NON ASBESTOS-FORM MATERIAL (%) CELLULOSE	FIBROUS GLASS	OTHER FIBERS
19457-B	1 Bethesda Village Clay	Het. Gray Slt. Fibrous	--	--	--	5-10	1-3	--

ABBREVIATIONS:

CROC.-CROCIDOLITE | TREM.-TREMOLITE | SYNTH.-SYNTHETIC FIBERS

ANTH.-ANTHOPHYLLITE | ACTIN.-ACTINOLITE | CaSil-CALCIUM SILICATES

COMMENTS:

MICROSCOPIST: Parvaneh Shakki

ANALYSIS DATE: 5-8-91

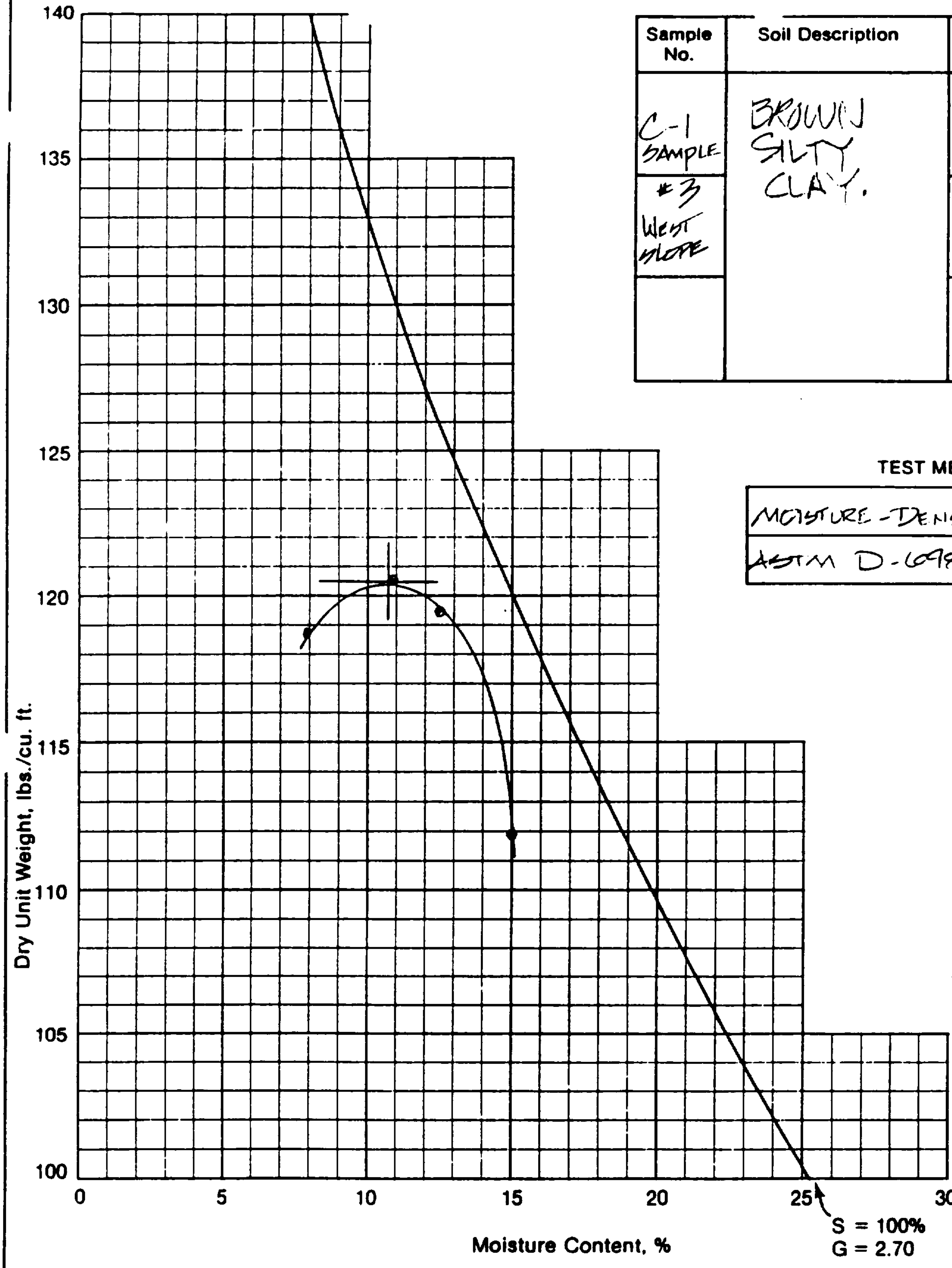
APPENDIX B-2

CLAY

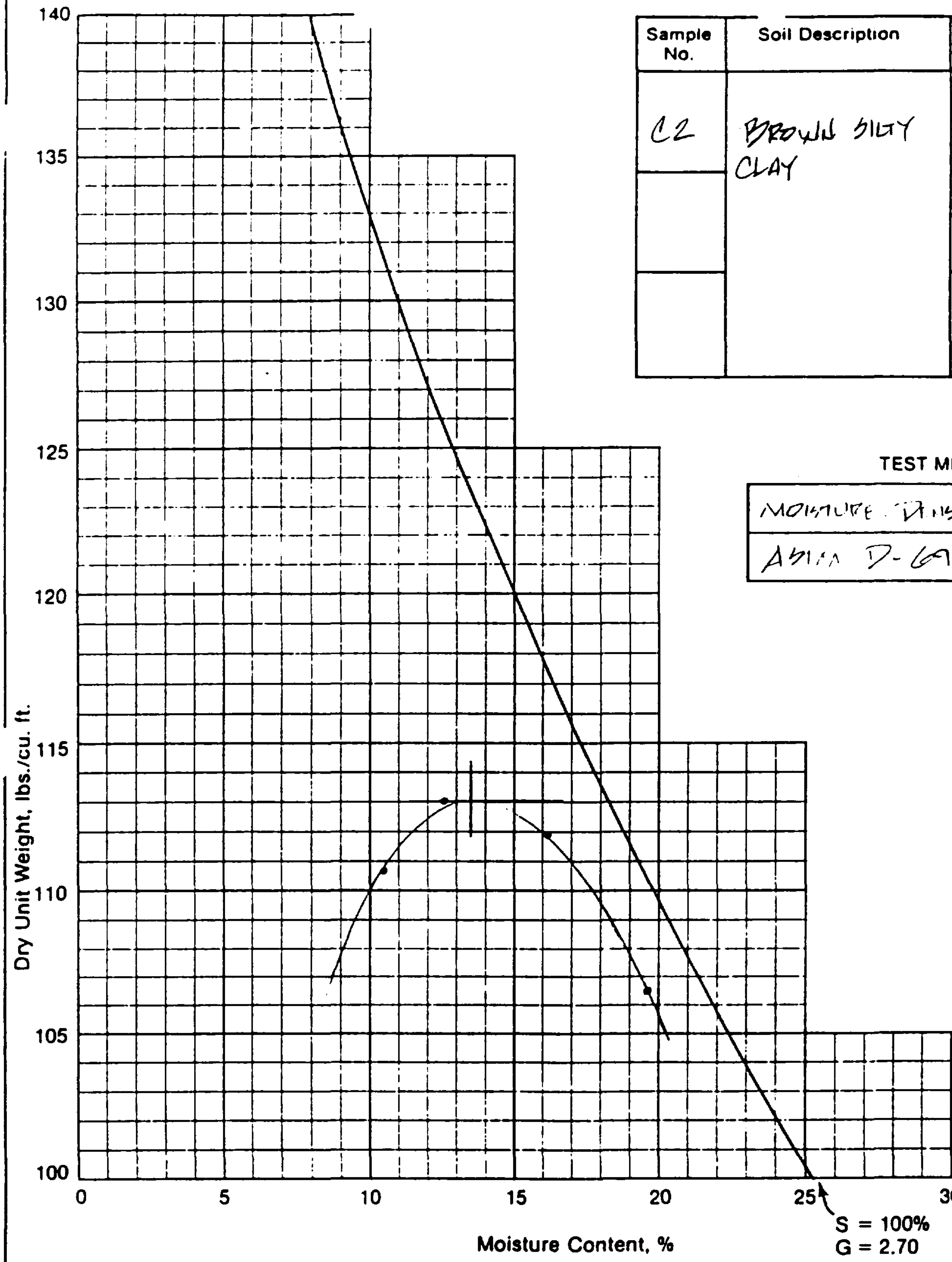
Sample No.	Soil Description	Max. Density	Optimum Mois.
C-1 SAMPLE #3 WEST SLOPE	BROWN SILTY CLAY.	120.5	10.8

TEST METHOD

MOISTURE-DENSITY RELATIONS
ASTM D-698 (STANDARD)



MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKB
MANVILLE REMEDIAL WORK WAUKEGAN, IL.	CONSULTING ENGINEERS	APPROVED BY	J.P.
	P.O. BOX 1231	DATE	6-13-89
	ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	JOB NO.	89233

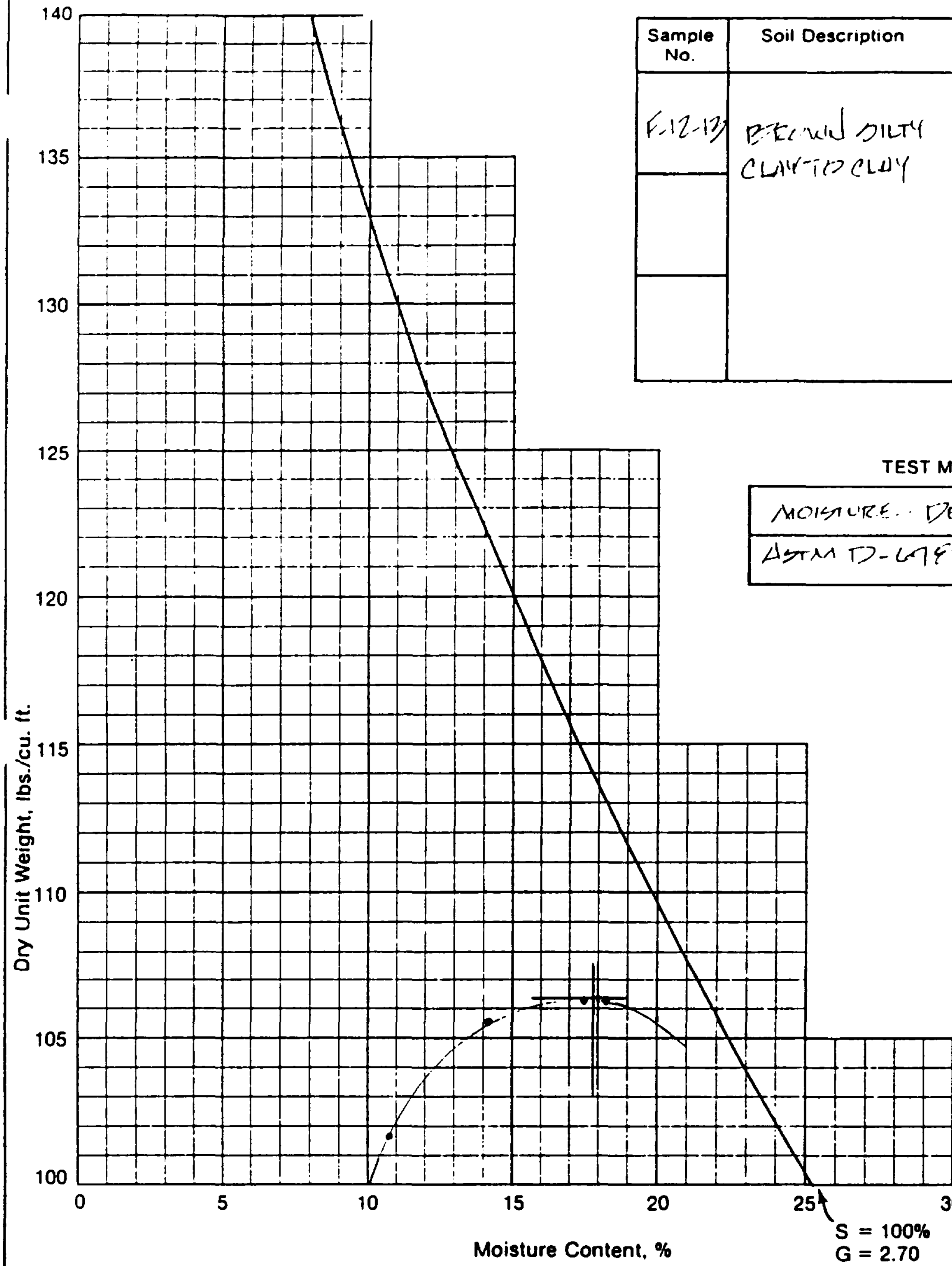


Sample No.	Soil Description	Max. Density	Optimum Mois.
C2	BROWN SILTY CLAY	113.0	13.5

TEST METHOD

MOISTURE DENSITY RELATIONSHIP
ASTM D-698 (STANDARD)

MOISTURE DENSITY CURVE MANVILLE REMEDIAL WORK WAUKEGAN, ILLINOIS	O'BRIEN & ASSOCIATES, INC. CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	DRAWN BY	C.K.B.
		APPROVED BY	JP
		DATE	6-12-89
		JOB NO.	89233

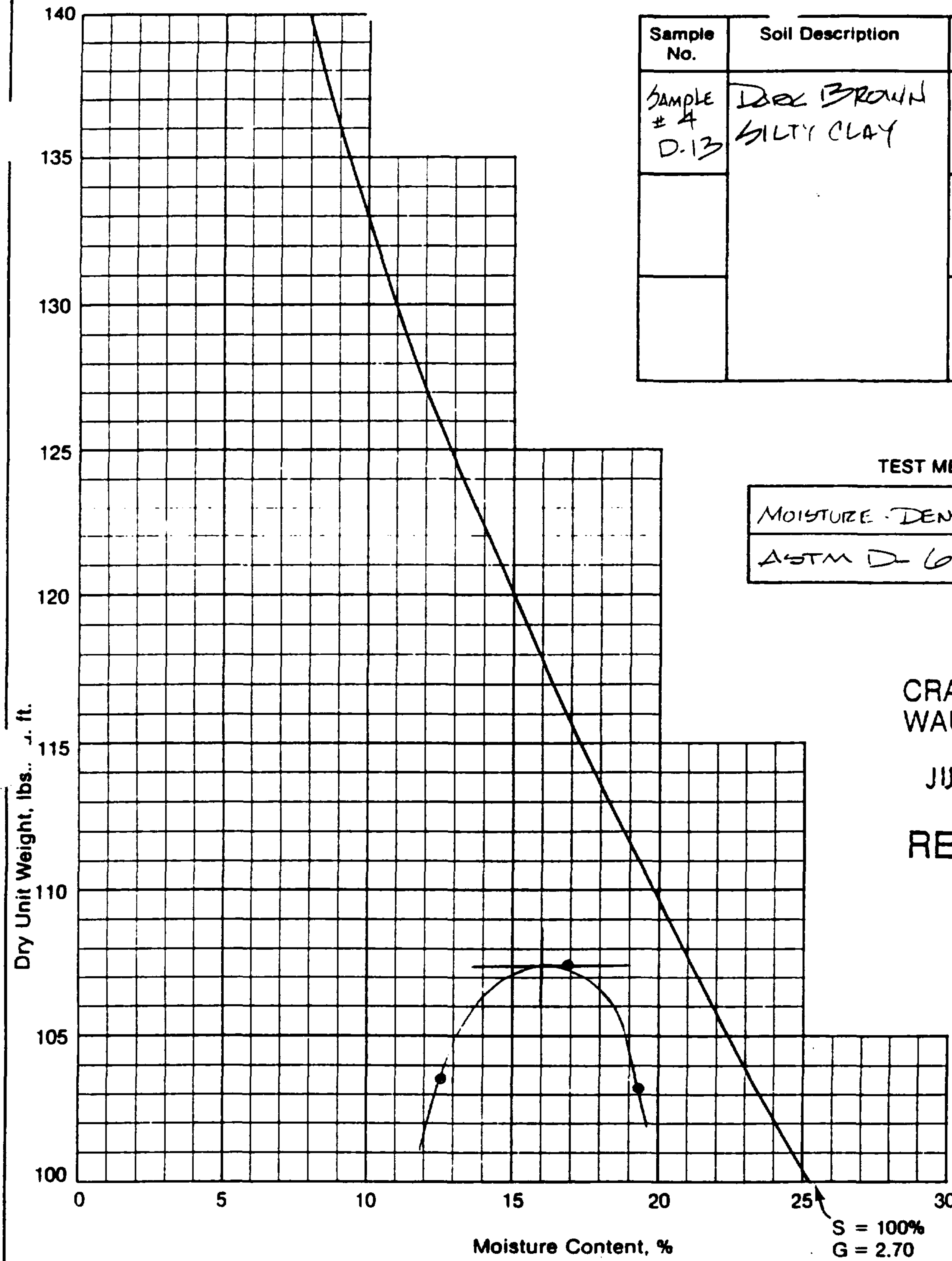


Sample No.	Soil Description	Max. Density	Optimum Mois.
F-12-13	BROWN SILTY CLAY TO CLAY	106.2	17.8

TEST METHOD

MOISTURE - DENSITY RELATION
ASTM D-698 (STANDARD)

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	C KIZ
MANVILLE - REMEDIAL WORK	CONSULTING ENGINEERS	APPROVED BY	JP
WAUKEGAN, ILLINOIS	P.O. BOX 1231	DATE	6-12-89
	ARLINGTON HEIGHTS, ILLINOIS	JOB NO.	89293
	(312) 398-1441		



Sample No.	Soil Description	Max. Density	Optimum Mois.
Sample # 4 D-13	Dark Brown Silty Clay	107.5	16.0

TEST METHOD

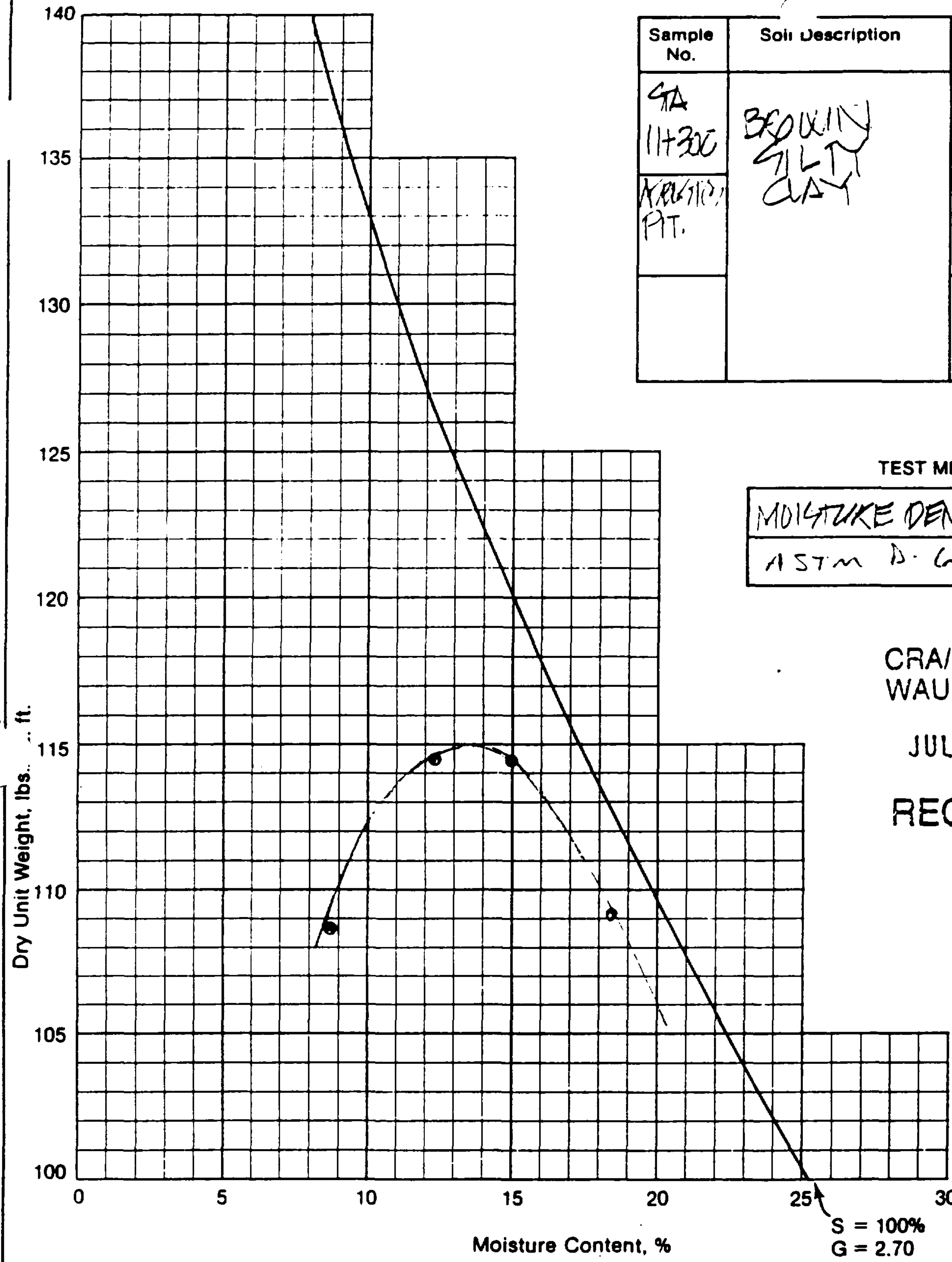
Moisture - Density Relations
ASTM D-698 (Standard)

CRA/MANVILLE
WAUKEGAN, IL

JUL 5 1989

RECEIVED

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKB
Manville Remedial Work Waukegan, Illinois	CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	APPROVED BY	JP
		DATE	6-13-89
		JOB NO.	89293



Sample No.	Soil Description	Max. Density	Optimum Mois.
STA 11+300 BORROW PIT.	BROWN SILTY CLAY	115.0	13.6

TEST METHOD

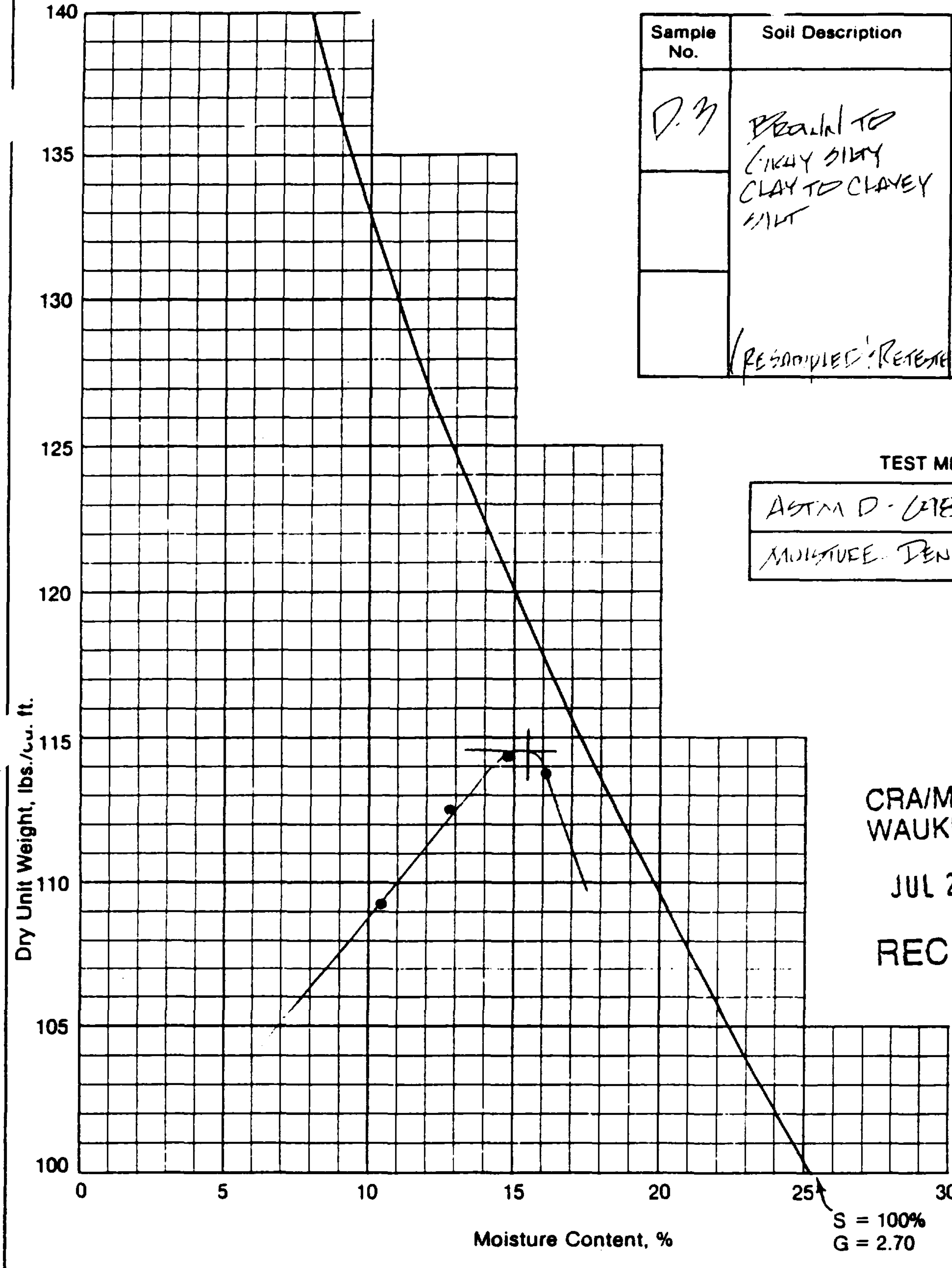
MOISTURE DENSITY RELATIONS
ASTM D-698 (STAND'D)

CRA/MANVILLE
WAUKEGAN, IL

JUL 7 1989

RECEIVED

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	[illegible]
MANVILLE REMEDIAL WORK WAUKEGAN, IL.	CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	APPROVED BY	J P
		DATE	7/5/89
		JOB NO.	[illegible]



Sample No.	Soil Description	Max. Density	Optimum Mois.
D-3	BROWN TO GRAY SILTY CLAY TO CLAYEY SILT (RESAMPLED/RETESTED)	114.5	15.5

TEST METHOD

ASTM D-698 (STANDARD)
MOISTURE-DENSITY RELATIONS

CRA/MANVILLE
WAUKEGAN, IL

JUL 20 1989

RECEIVED

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKP
MANVILLE REMEDIAL WORK WAUKEGAN, ILLINOIS	CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	APPROVED BY	JP
		DATE	7-6-89
		JOB NO.	89233

SUMMARY OF ORGANIC CONTENT
AND pH FOR SOIL SAMPLES
MANVILLE REMEDIAL WORK
WAUKEGAN, ILLINOIS

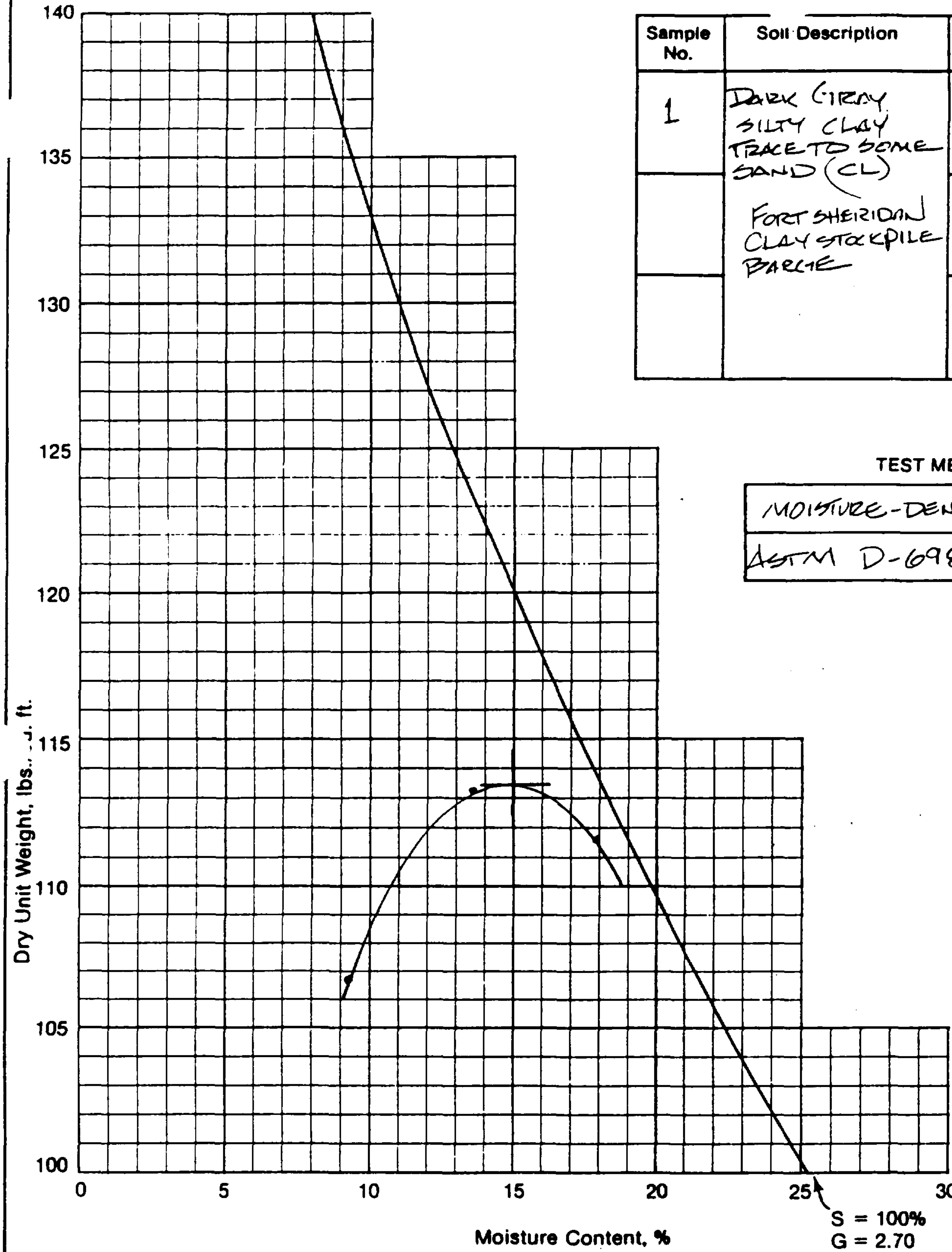
Job No. 89233

Sample #	Location	Material Description	Organic Content (%)	pH
(1)	Fort Sheridan Clay Stockpile Barge	Dark gray silty clay trace to some sand (CL)	3.0	8.0
(2)	Grand & TriState	Brown silty clay trace to some sand (CL)	5.1	7.3
(3)	Pembrook	Brown silty clay trace topsoil some sand (CL)	4.9	8.2
(4)	US Route 137 & Sheridan Road Pond Area	Brown and gray clayey silt some sand (ML-CL)	2.4	8.8
(5)	US Route 137 & Sheridan Road Pond Area	Gray clayey silt trace sand (CL-ML)	1.6	8.8

CRA/MANVILLE
WAUKEGAN, IL

AUG 24 1989

RECEIVED



Sample No.	Soil Description	Max. Density	Optimum Mois.
1	DARK GRAY SILTY CLAY TRACE TO SOME SAND (CL)	113.5	15.0
	FORT SHERIDAN CLAY STOCKPILE BARGE		

TEST METHOD

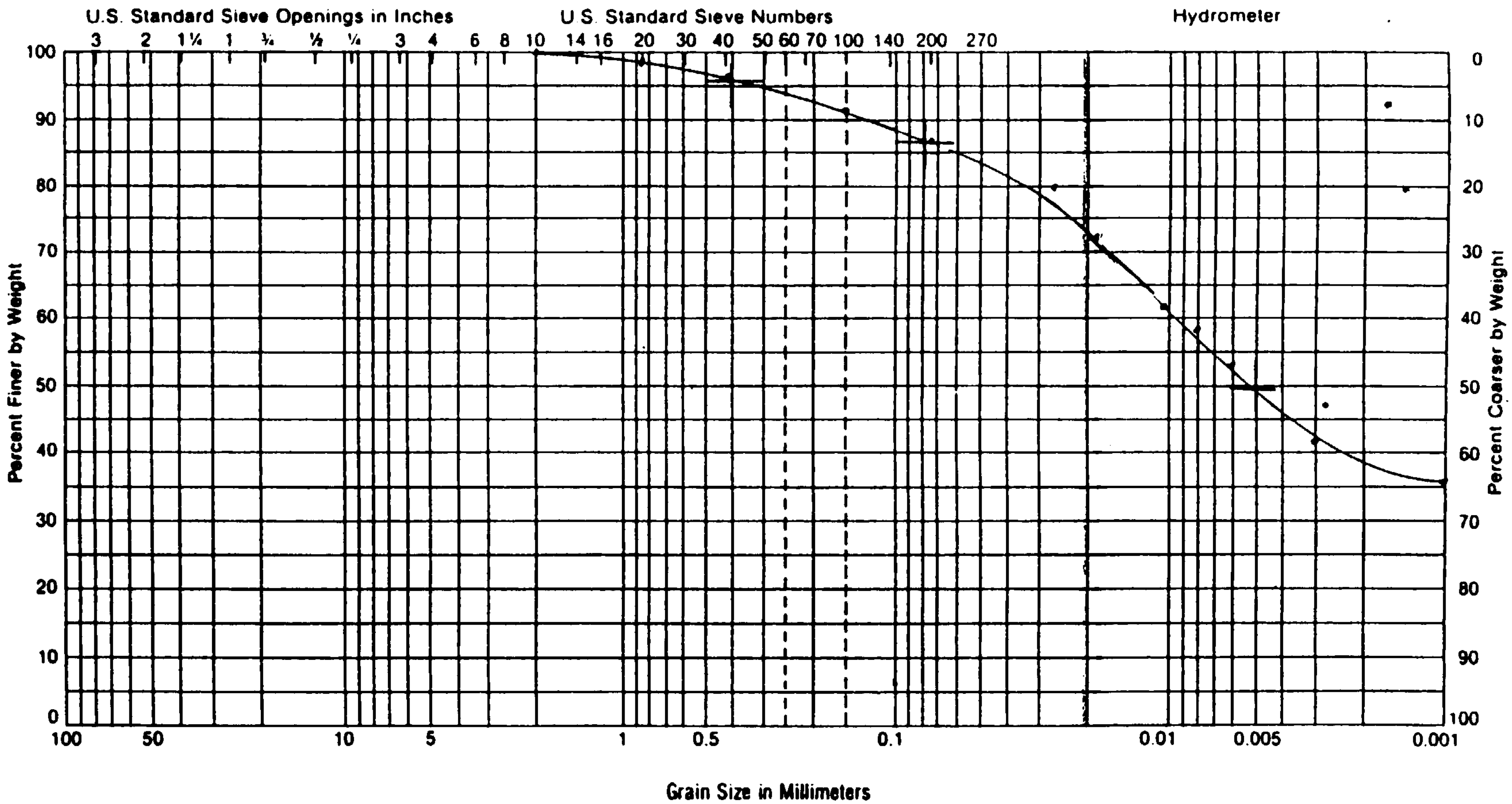
MOISTURE-DENSITY RELATIONS
ASTM D-698 (STANDARD)

MOISTURE DENSITY CURVE

MANVILLE REMEDIAL WORK
WAUKEGAN, IL.

O'BRIEN & ASSOCIATES, INC.
CONSULTING ENGINEERS
P.O. BOX 1231
ARLINGTON HEIGHTS, ILLINOIS
(312) 398-1441

DRAWN BY	CKB
APPROVED BY	J.P
DATE	7-25-89
JOB NO.	89233



GRAVEL			SAND			SILT or CLAY
Coarse	Medium	Fine	Coarse	Medium	Fine	

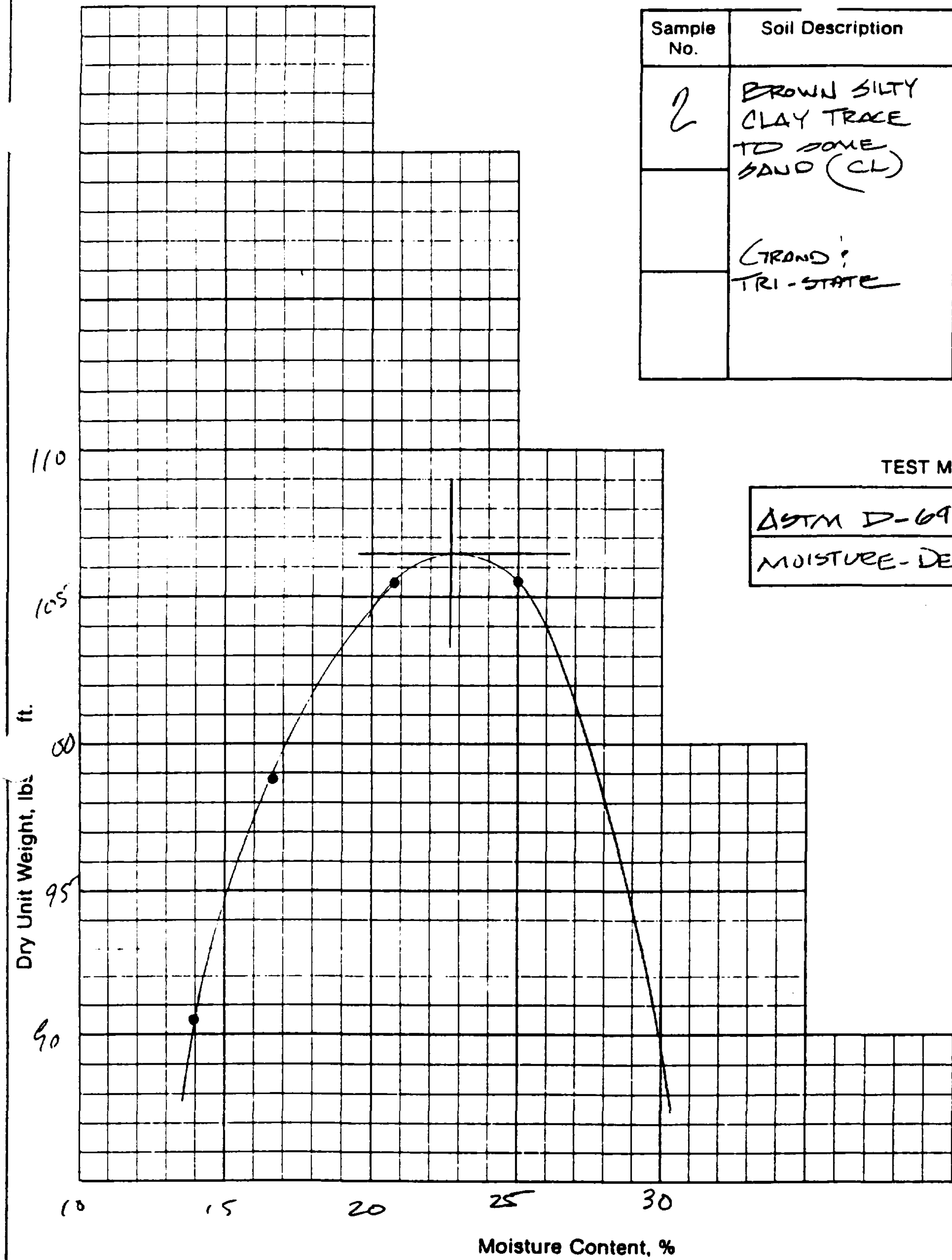
SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
1	10.3%	24%	13%	11	DARK GRAY SILTY CLAY TRACE TO SOME SAND
					(CL)
					50 % CLAY (.005 mm ϕ)
					36 % SILT
					14 % SAND
					SAMPLED FROM: FORT SHERIDAN
					CLAY STOCKPILE ; BARGE

MANVILLE REMEDIAL WORK
WAUKEGAN, IL.

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
C.B.	JP	8/15/89	89233

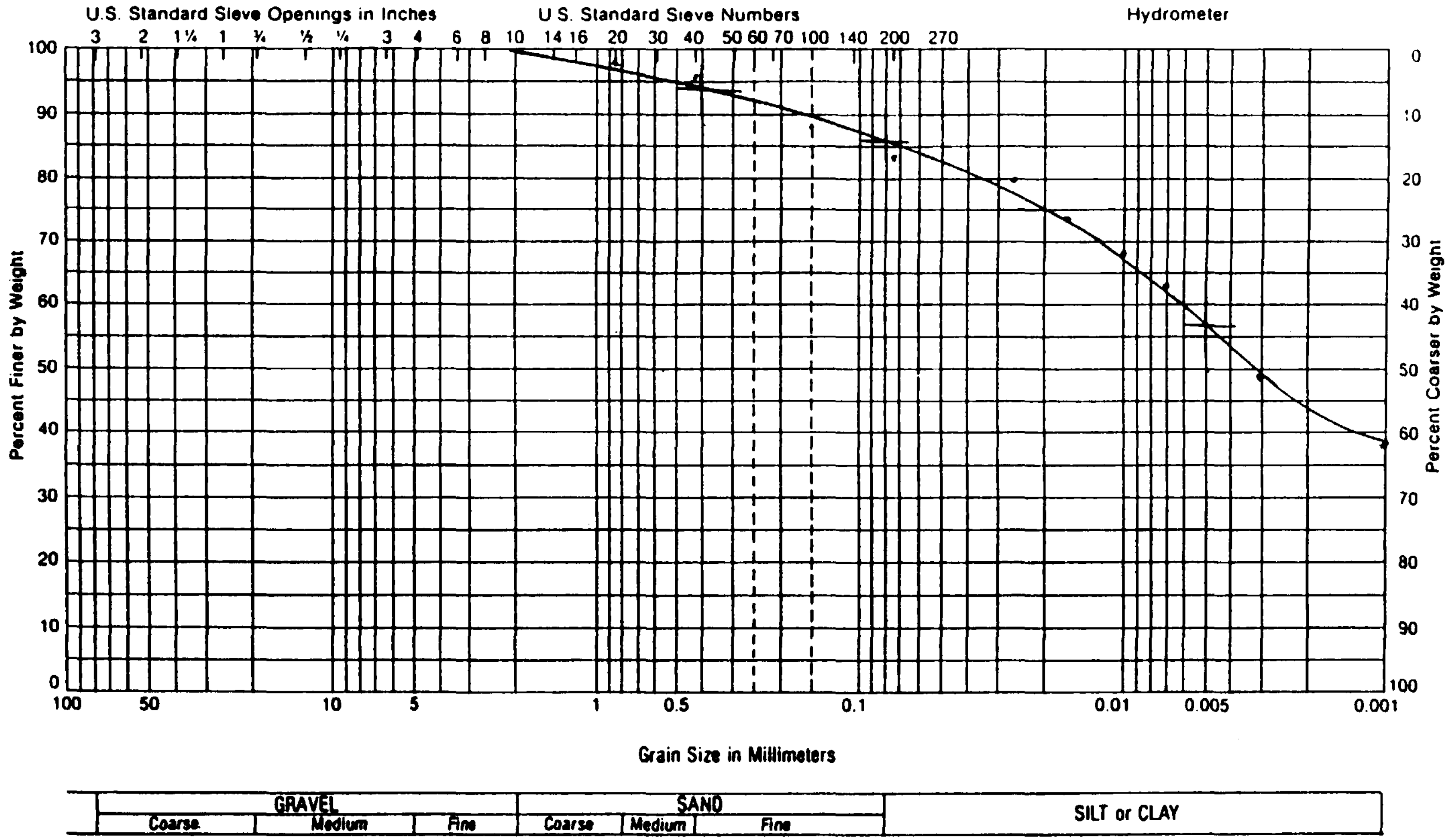
Sample No.	Soil Description	Max. Density	Optimum Mois.
2	BROWN SILTY CLAY TRACE TO SOME SAND (CL)	106.4	22.7
	GROUND: TRI-STATE		



TEST METHOD

ASTM D-698
MOISTURE-DENSITY RELATIONS

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	D.M.L
ANVILLE REMEDIAL WORK WAUKEGAN, IL.	CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	APPROVED BY	J.P
		DATE	8/10/89
		JOB NO.	89293



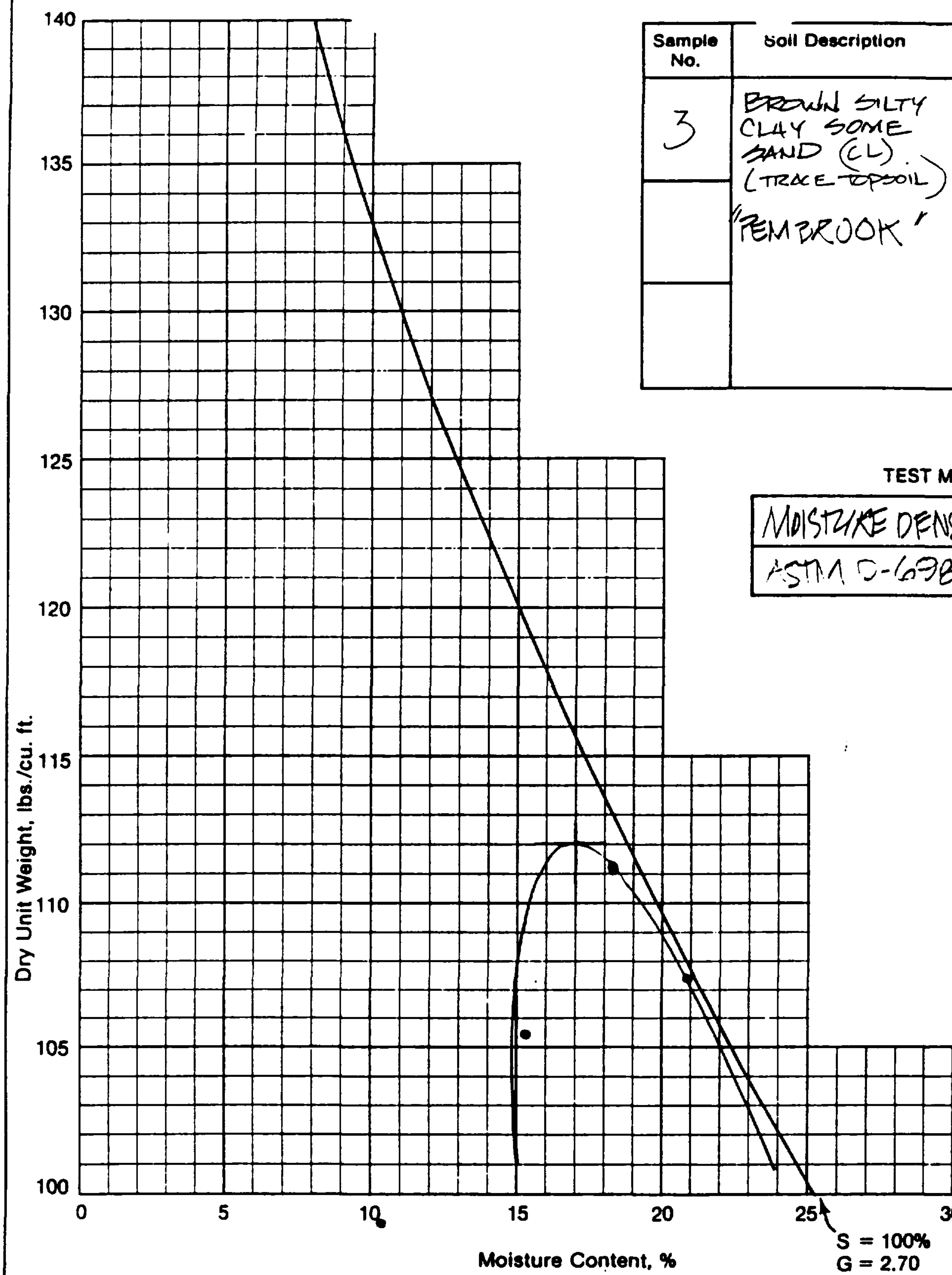
SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
2	20.7%	46%	22%	24	BROWN SILTY CLAY TRACE TO SOME SAND
					(CL)
					57% CLAY (.005 mm ϕ)
					29% SILT
					14% SAND
					SAMPLED FROM: GRAND, TRI-STATE

MANVILLE REMEDIAL WORK
WAUKEGAN, IL

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
C.K.B.	J.P.	8/15/87	89233

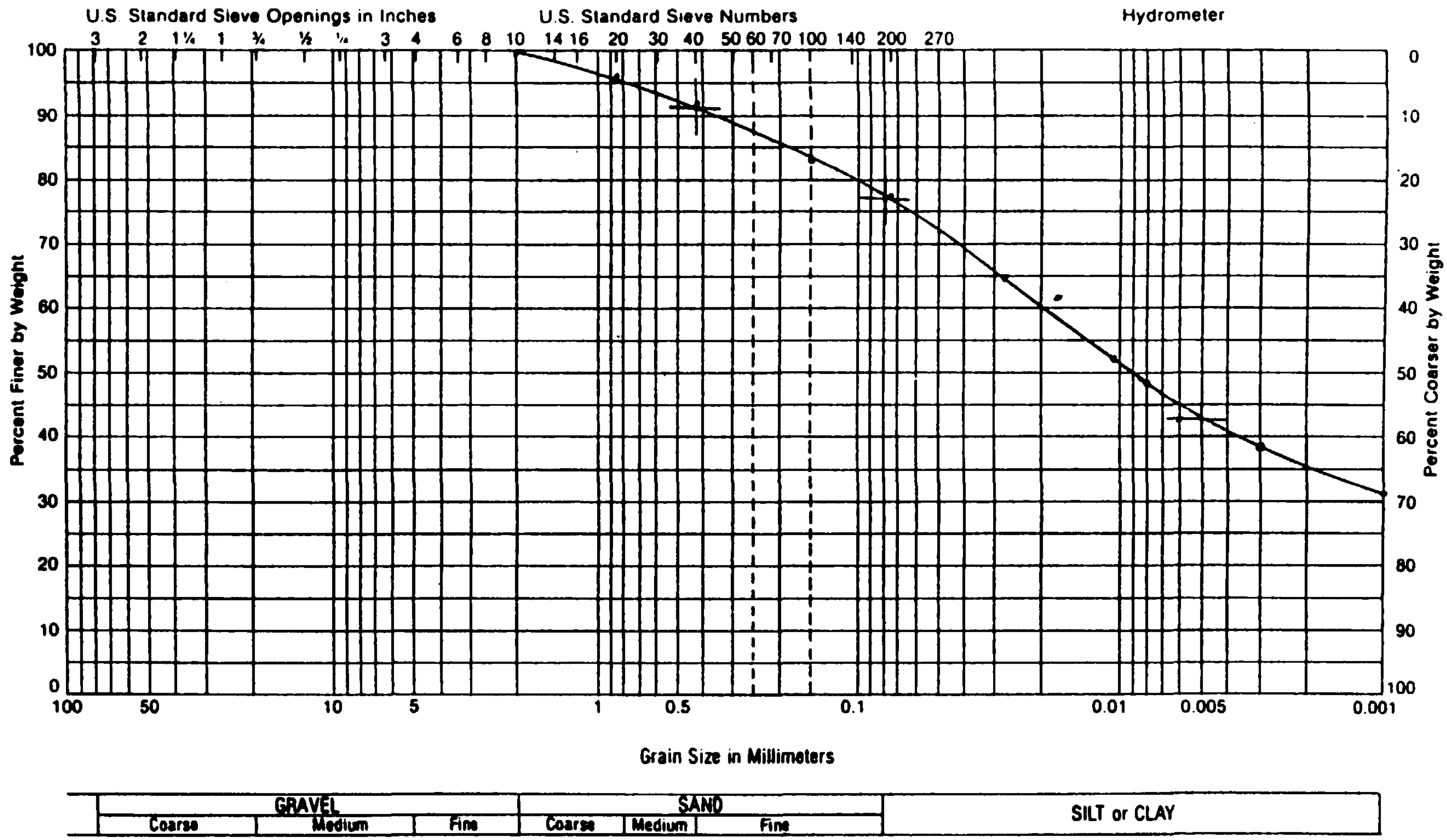
Sample No.	Soil Description	Max. Density	Optimum Mois.
3	BROWN SILTY CLAY SOME SAND (CL) (TRACE TOPSOIL) "PEMBROOK"	112.0	17.0



TEST METHOD

MOISTURE DENSITY RELATIONS
ASTM D-698 (STAND'D).

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	L.M.D.
MANVILLE REMEDIAL [illegible] WAUKEGAN, IL.	CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	APPROVED BY	JP
		DATE	7/31/89
		JOB NO.	89233

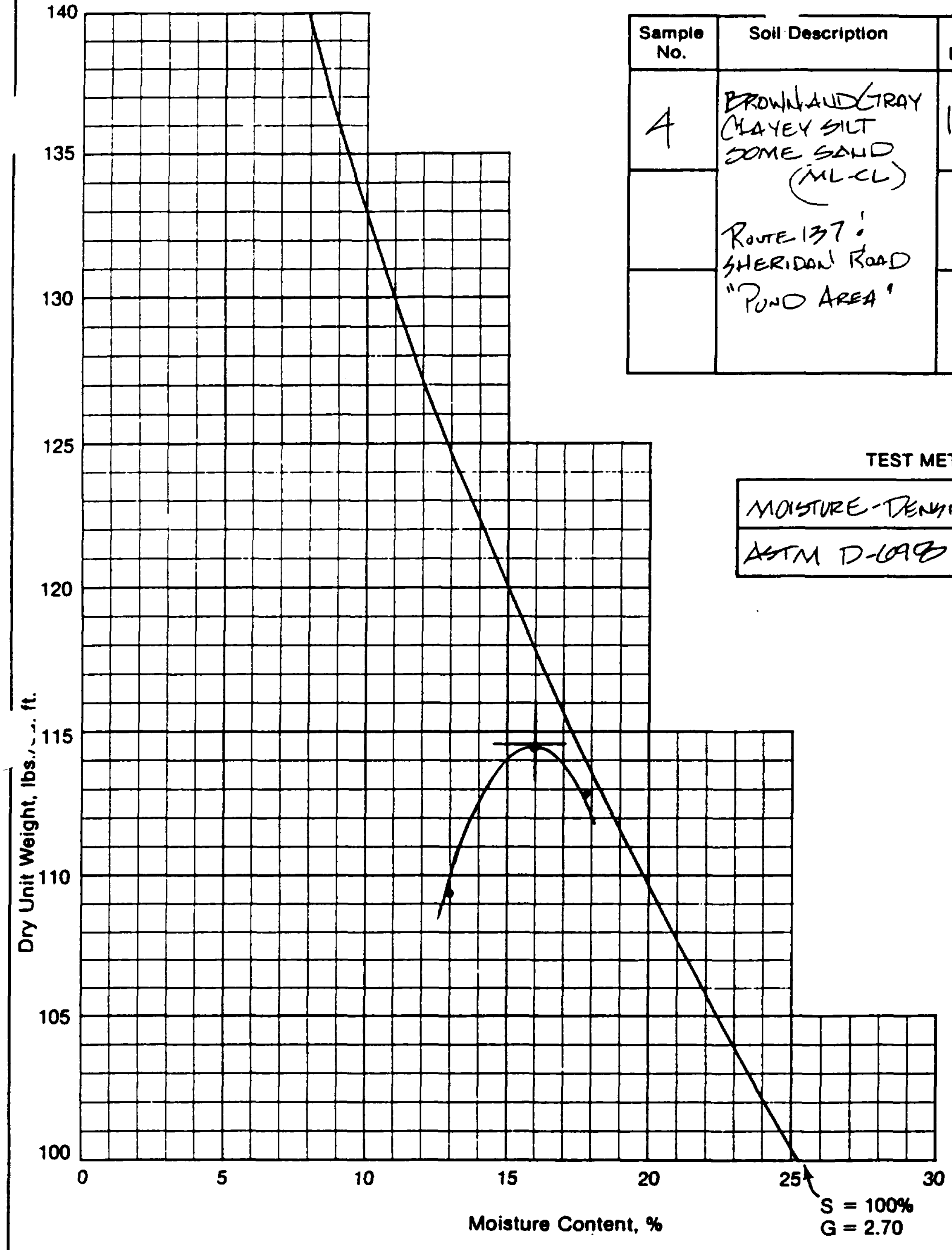


SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
3	16.2%	34.0%	16.0%	18	BROWN SILTY CLAY SOME SAND
					(TRACE TOPSOIL)
					43% CLAY (.005 mm D)
					34% SILT
					23% SAND
					SAMPLED FROM: PENSTOCK

MANVILLE REMEDIAL WORK
WAUKEGAN, IL.

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
CKB.	[illegible]	8/15/09	891233

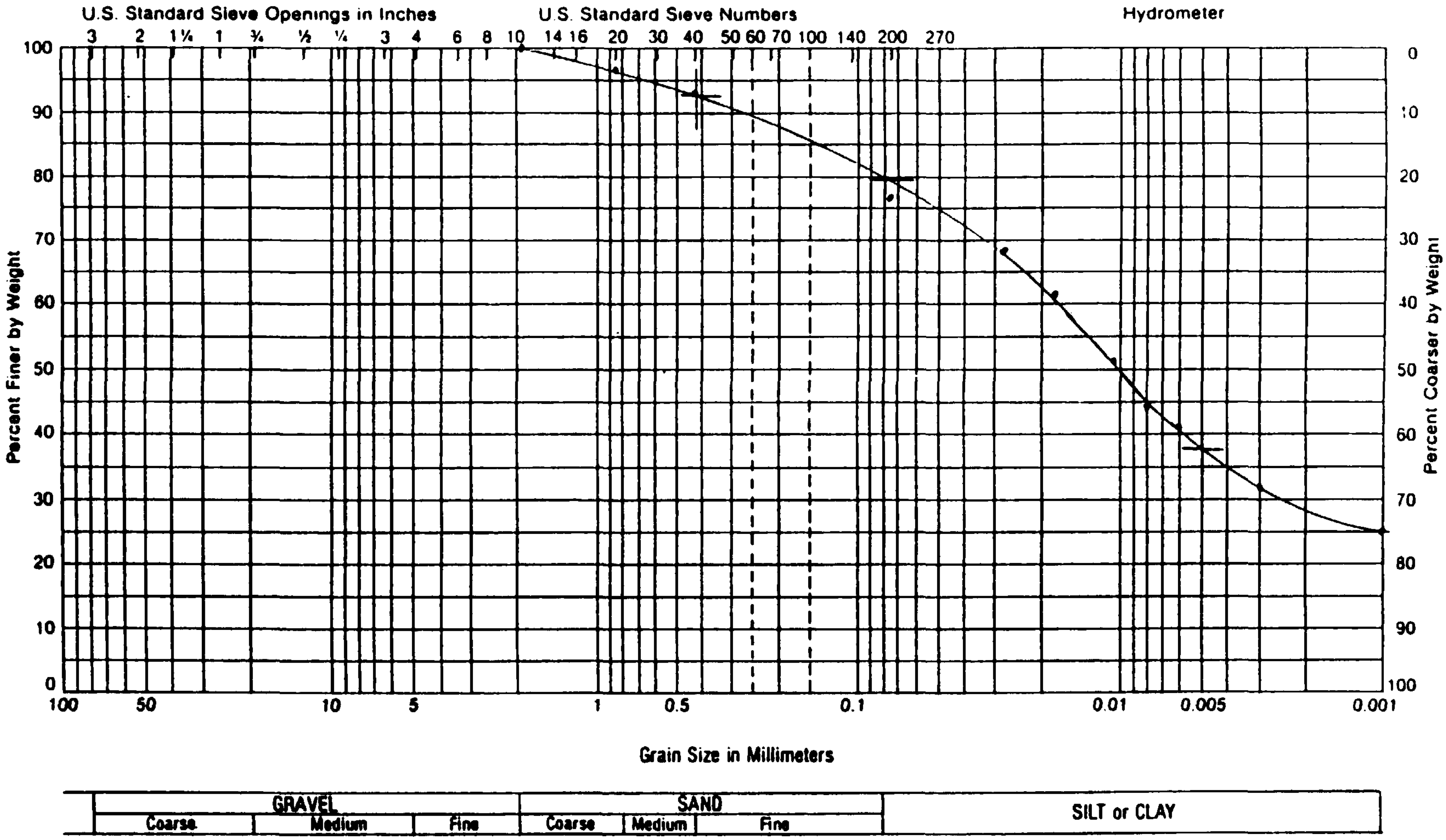


Sample No.	Soil Description	Max. Density	Optimum Mois.
4	BROWN AND GRAY CLAYEY SILT SOME SAND (ML-CL)	114.7	16.0
	ROUTE 137 : SHERIDAN ROAD "POND AREA"		

TEST METHOD

MOISTURE-DENSITY RELATIONS
ASTM D-698 (STANDARD)

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKP
MANVILLE REMEDIAL WORK WAUKEGAN, IL	CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	APPROVED BY	
		DATE	7-25-89
		JOB NO.	89233



SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
4	18.2%	19%	12%	7	BROWN AND GRAY CLAYEY SILT, SOME SAND
					(ML-CL)
					42% SILT
					38% CLAY (.005 mm cb)
					20% SAND
					SAMPLED FROM: ROUTE 137 & SHERIDAN RD.
					"POND AREA"

MANVILLE REMEDIAL WORK
WAUKEGAN, IL

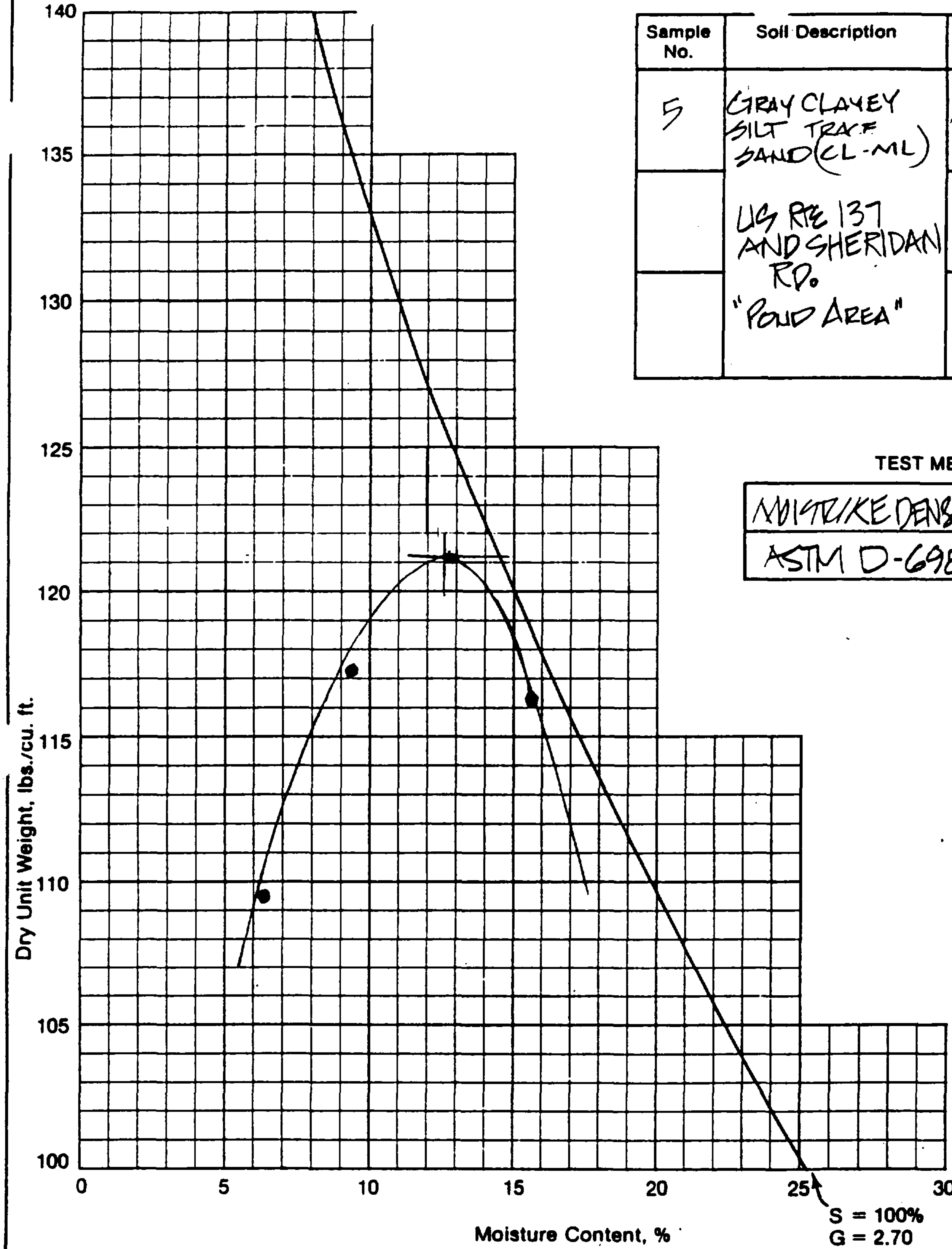
O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
C.K.B.	J.P.	8/15/89	89233

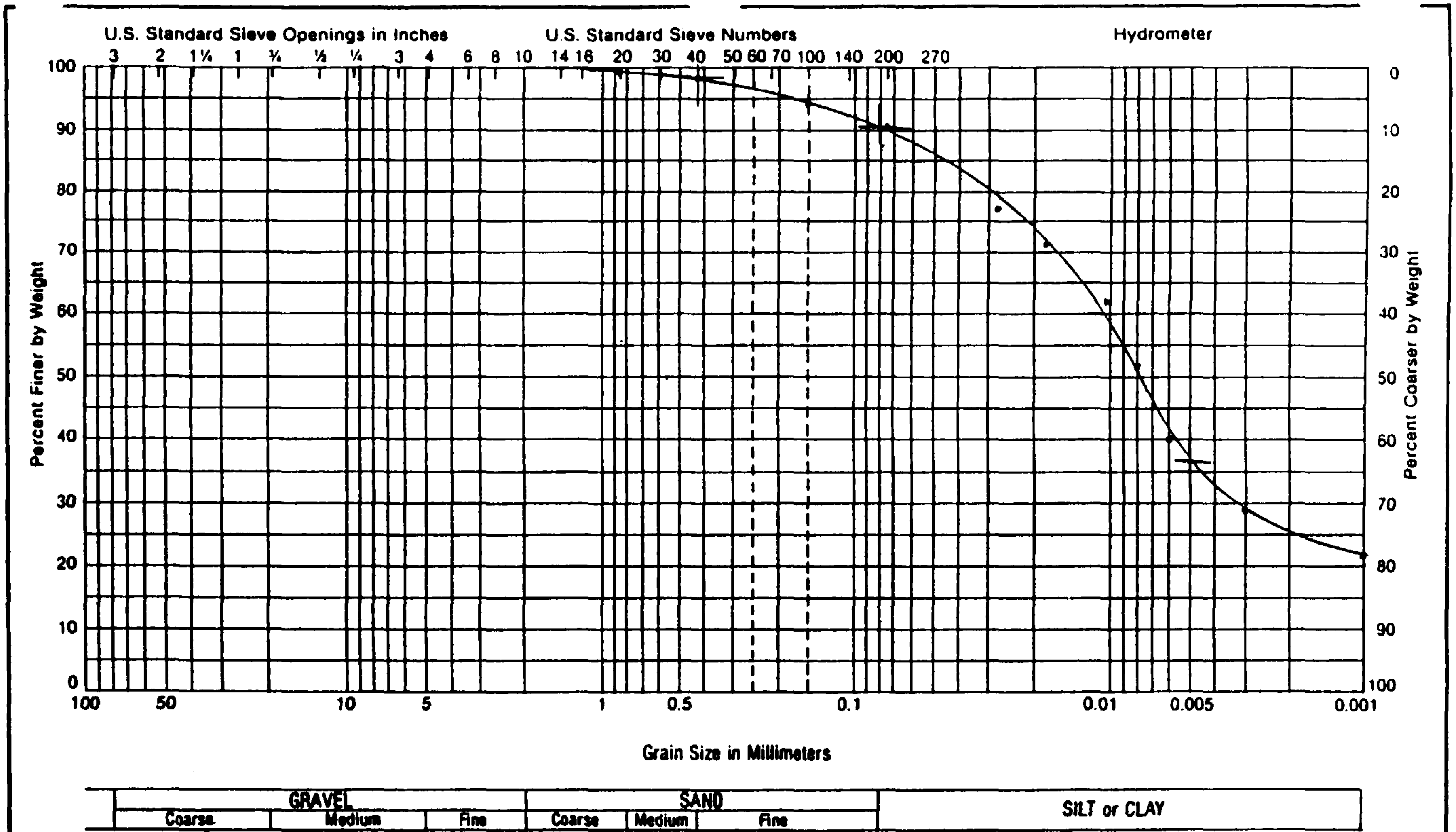
Sample No.	Soil Description	Max. Density	Optimum Mois.
5	GRAY CLAYEY SILT TRACE SAND (CL-ML)	121.2	12.5
	US RTE 137 AND SHERIDAN RD.		
	"POND AREA"		

TEST METHOD

MOISTURE DENSITY RELATIONS
ASTM D-698 (STANDARD)



MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	D.M.N.
MANVILLE REMEDIAL WORK WAUKEGAN, IL.	CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	APPROVED BY	J.P.
		DATE	7/31/89
		JOB NO.	89233

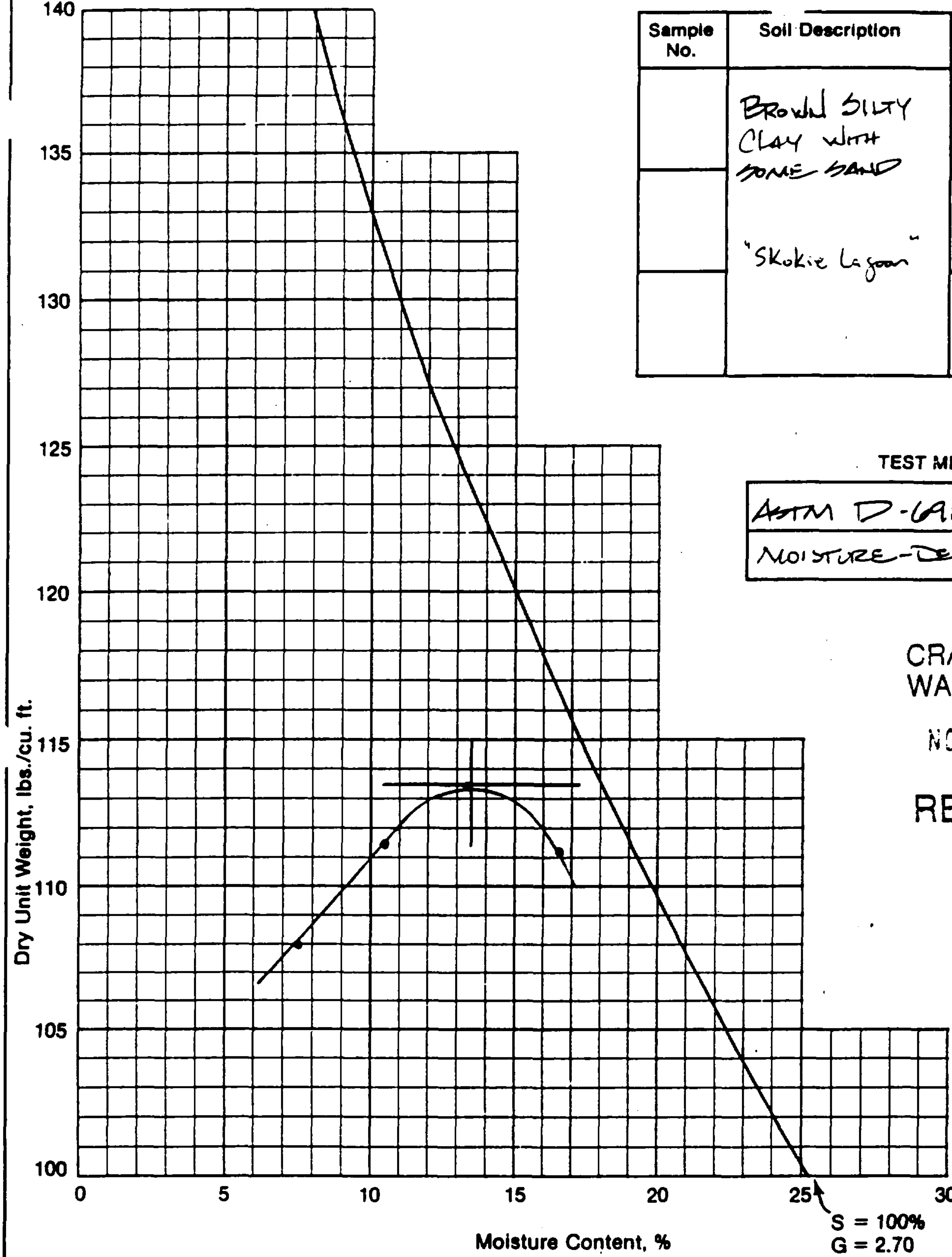


SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
5	13.7%	18%	14%	4	GRAY CLAYEY SILT TRACE SAND (CL-ML)
					53% SILT
					37% CLAY (.005 mm ϕ)
					10% SAND
					SAMPLED FROM: ROUTE 137 &
					SHERIDAN ROAD - "POND AREA"

MANVILLE REMEDIAL WORK
WAUKEGAN, IL

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
C.K.B.	J. P.	8/15/89	89233



Sample No.	Soil Description	Max. Density	Optimum Mois.
	BROWN SILTY CLAY WITH SOME SAND	113.5	13.5
	"Skokie Lagoon"		

TEST METHOD

ASTM D-698 (STANDARD)
MOISTURE-DENSITY RELATIONS

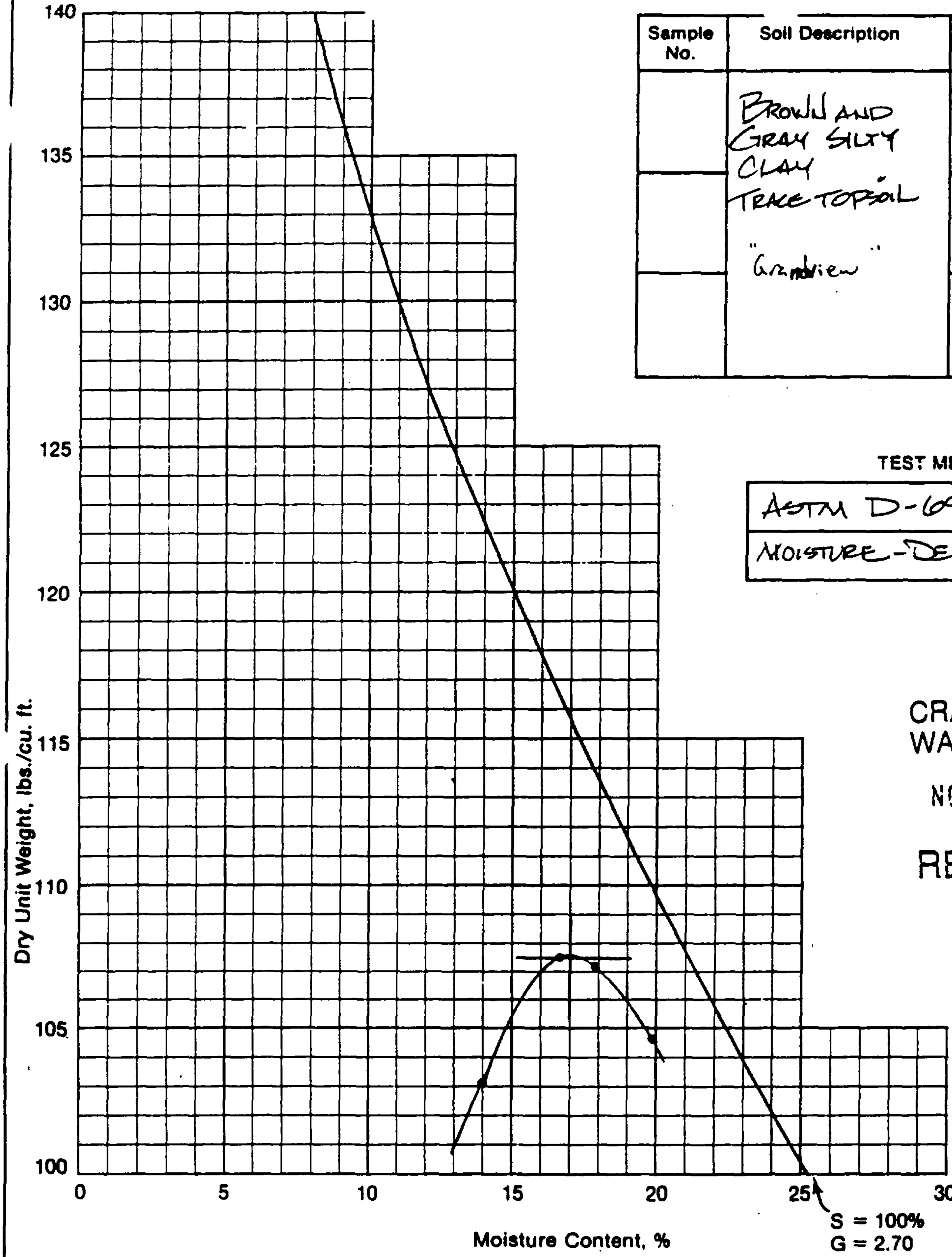
CRA/MANVILLE
WAUKEGAN, IL

NOV 1 1989

RECEIVED

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKP
MANVILLE REMEDIAL WORK WAUKEGAN, ILLINOIS	CONSULTING ENGINEERS	APPROVED BY	J.P.
	P.O. BOX 1231	DATE	10/11/89
	ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	JOB NO.	89233

Sample No.	Soil Description	Max. Density	Optimum Mois.
	BROWN AND GRAY SILTY CLAY TRACE TOPSOIL "Grandview"	107.5	17.0



TEST METHOD

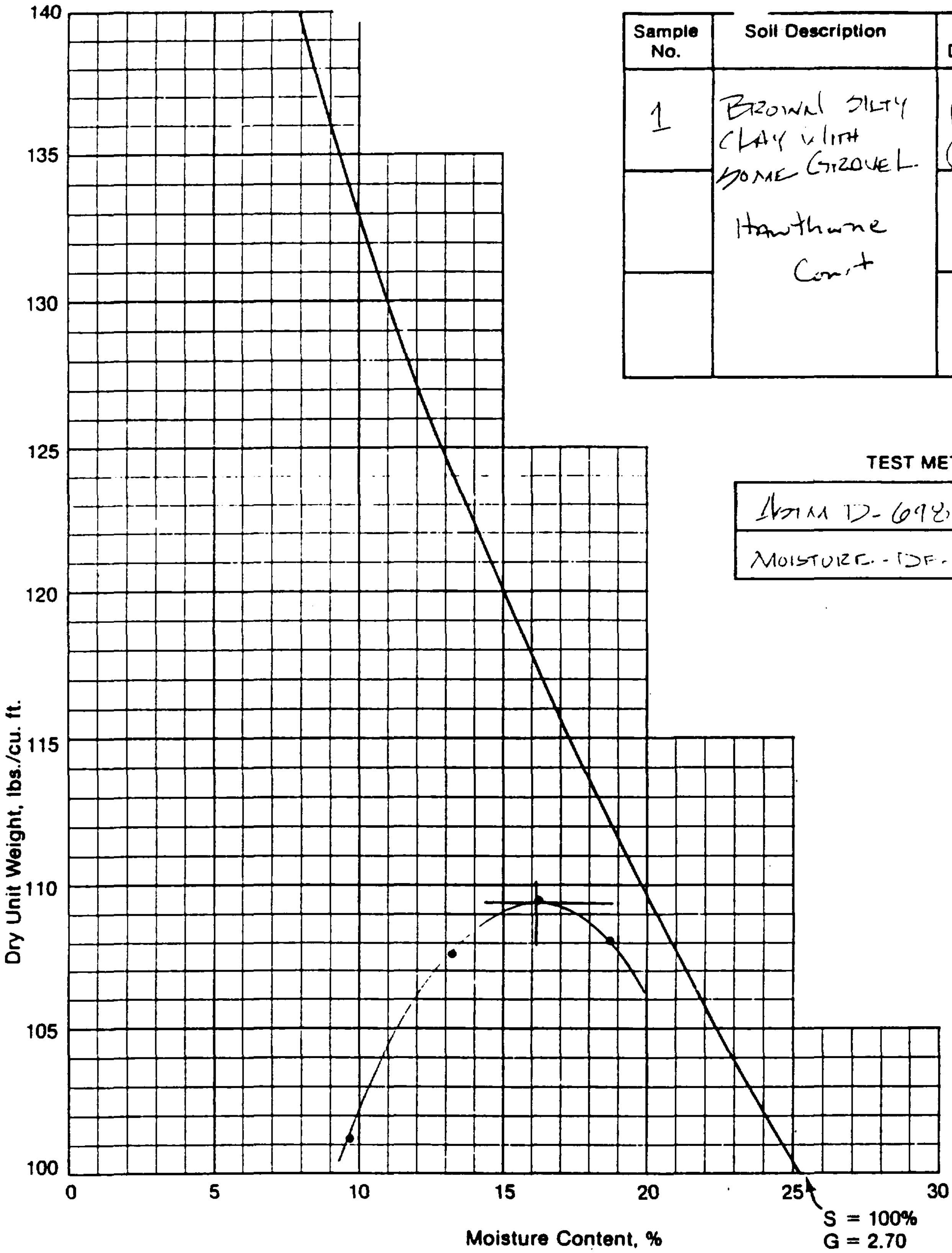
ASTM D-698 (STANDARD)
MOISTURE-DENSITY RELATIONSHIP

CRA/MANVILLE
WAUKEGAN, IL

NOV 1 1989

RECEIVED

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKB
MANVILLE REMEDIAL WORK WAUKEGAN, ILLINOIS	CONSULTING ENGINEERS	APPROVED BY	J.P.
	P.O. BOX 1231	DATE	9-3-89
	ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	JOB NO.	89233

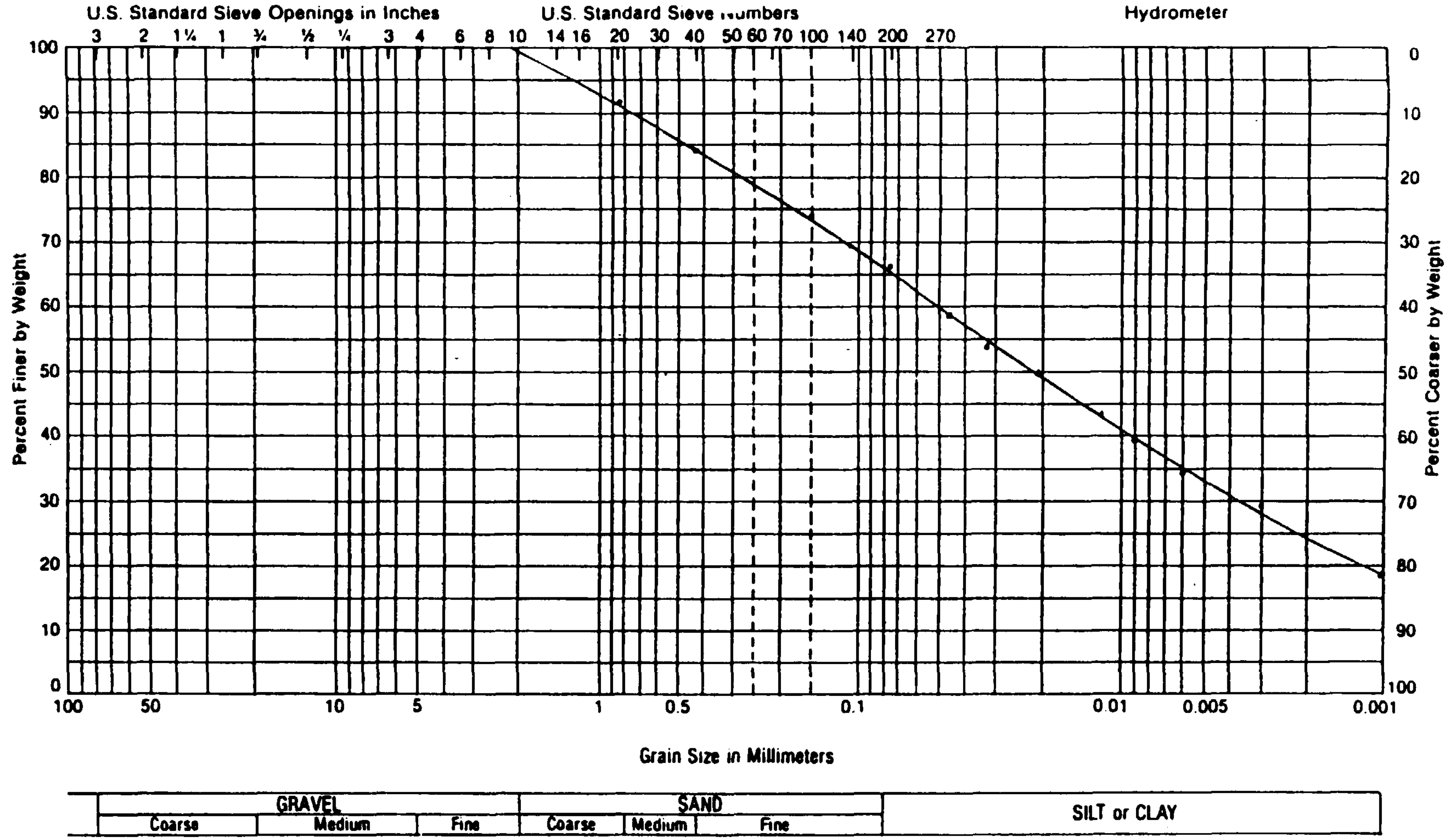


Sample No.	Soil Description	Max. Density	Optimum Mois.
1	Brown silty clay with some gravel Hawthorne Const	109.5 (pcf)	16.2 (%)

TEST METHOD

ASTM D-698 (Standard)
Moisture-Density Relations

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKB
Hawthorne Const	CONSULTING ENGINEERS	APPROVED BY	J.P.
MANVILLE REMEDIAL WORK	P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS	DATE	11/8/91
WAUKEGAN, IL.	(312) 398-1441	JOB NO.	81293



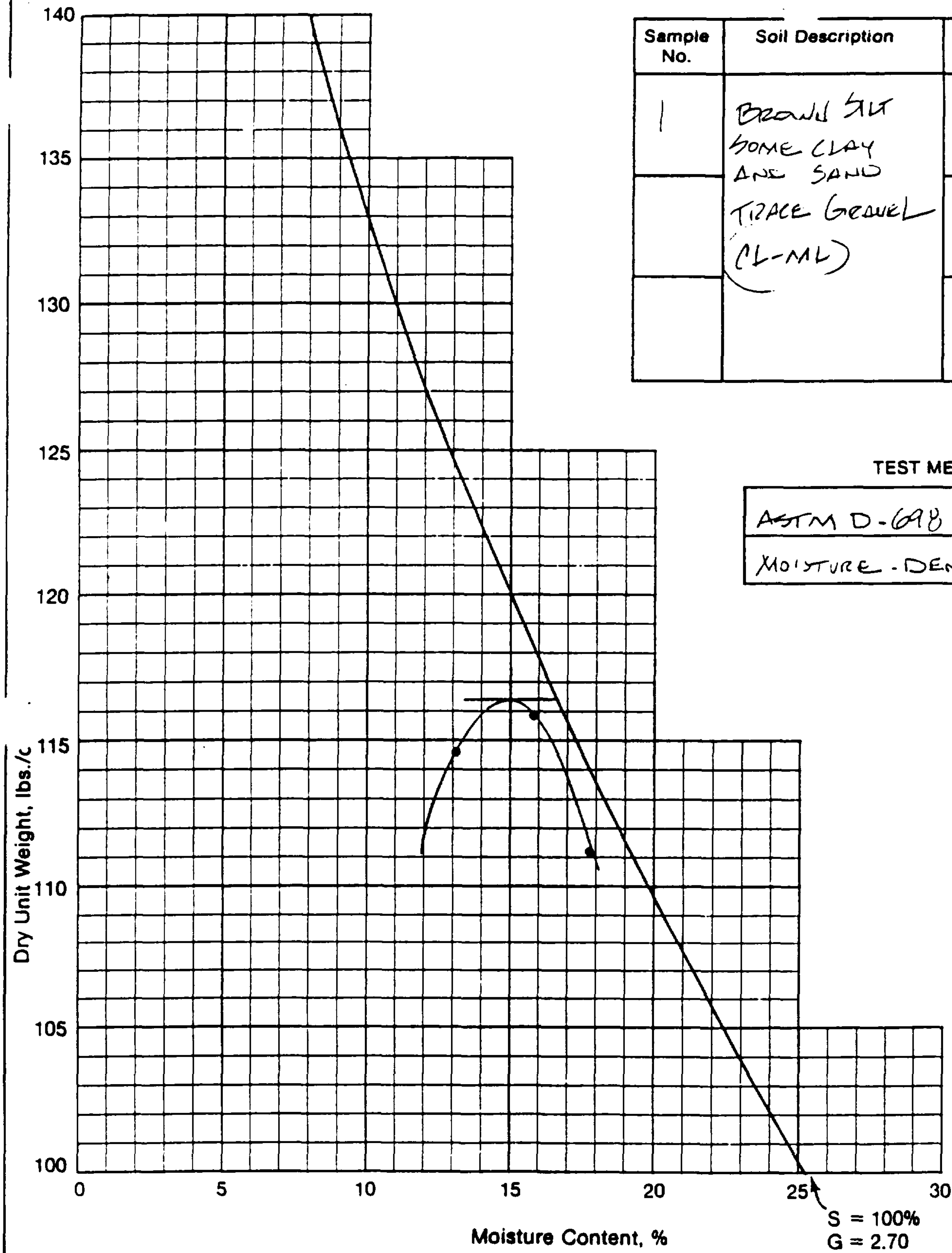
?

SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
		35%	21%	21%	BROWN SILTY CLAY (CL) SOME SAND
				14%	SB1
CRA/MANVILLE					
WAUKEGAN, IL					34% SAND
DEC 5 1999					66% CLAY AND SILT
RECEIVED					

HAWTHORNE COURT
MANVILLE REMEDIAL WORK
WAUKEGAN, ILLINOIS

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
CKD		11/21/99	89293

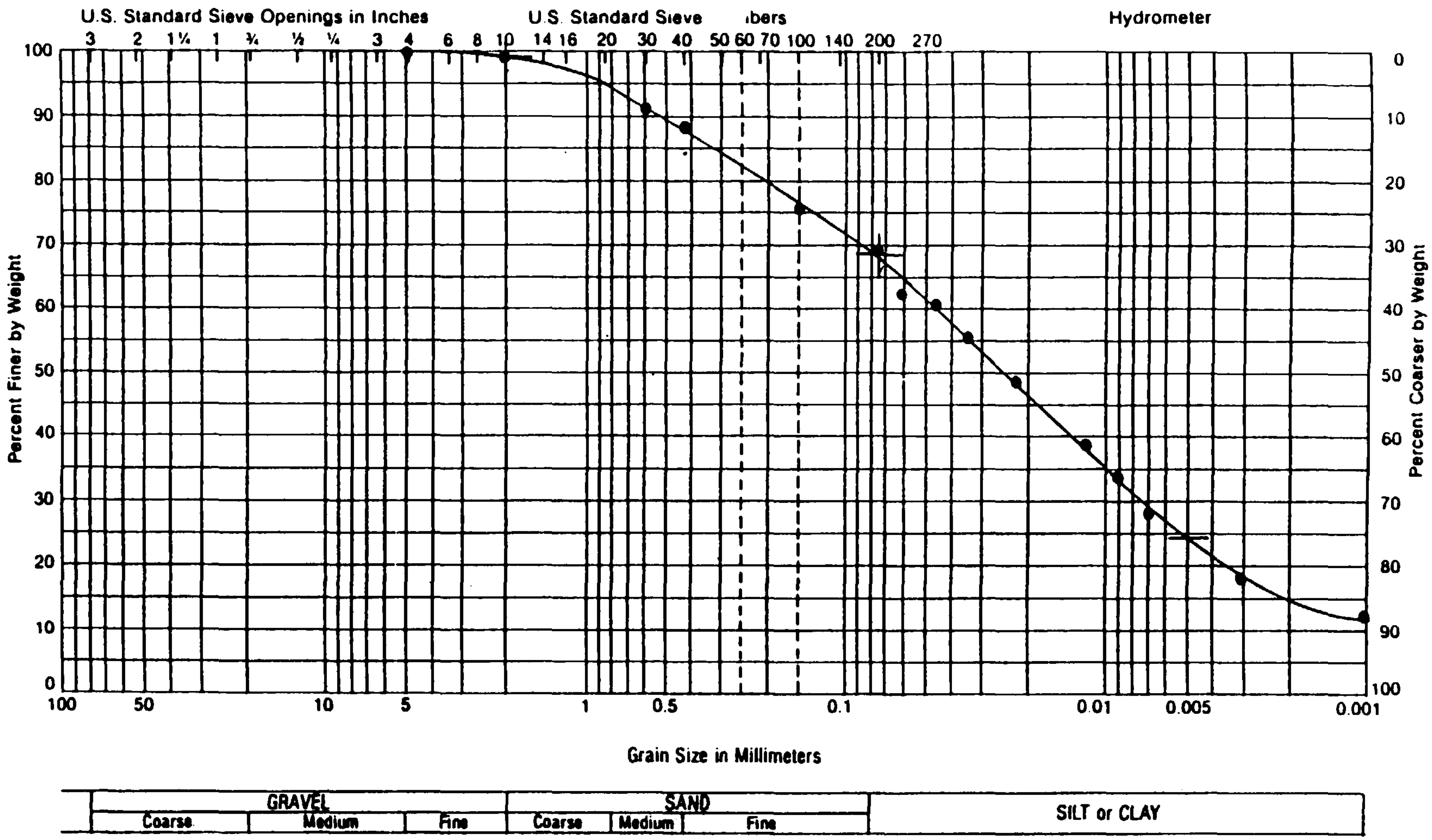


Sample No.	Soil Description	Max. Density	Optimum Mois.
1	BROWN SILT SOME CLAY AND SAND TRACE GRAVEL (CL-ML)	116.5	15.0

TEST METHOD

ASTM D-698 STANDARD
MOISTURE - DENSITY RELATIONS

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKD
MANVILLE REMEDIAL WORK	CONSULTING ENGINEERS	APPROVED BY	J.P.
SOURCE: SOUTH STOCKPILE	P.O. BOX 1231	DATE	8-21-90
COMPOSITE CLAY STOCKPILE	ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	JOB NO.	90233



SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
#1		18	13	5	BROWN SILT (CL-ML)
					SOME CLAY AND SAND / TRACE GRAVEL
					45% SILT
					31% SAND
					23% CLAY (0.005 MM)
					1% GRAVEL

MANVILLE REMEDIAL WORK
SOURCE : SOUTH STOCKPILE
COMPOSITE CLAY PILE (ON-SITE)

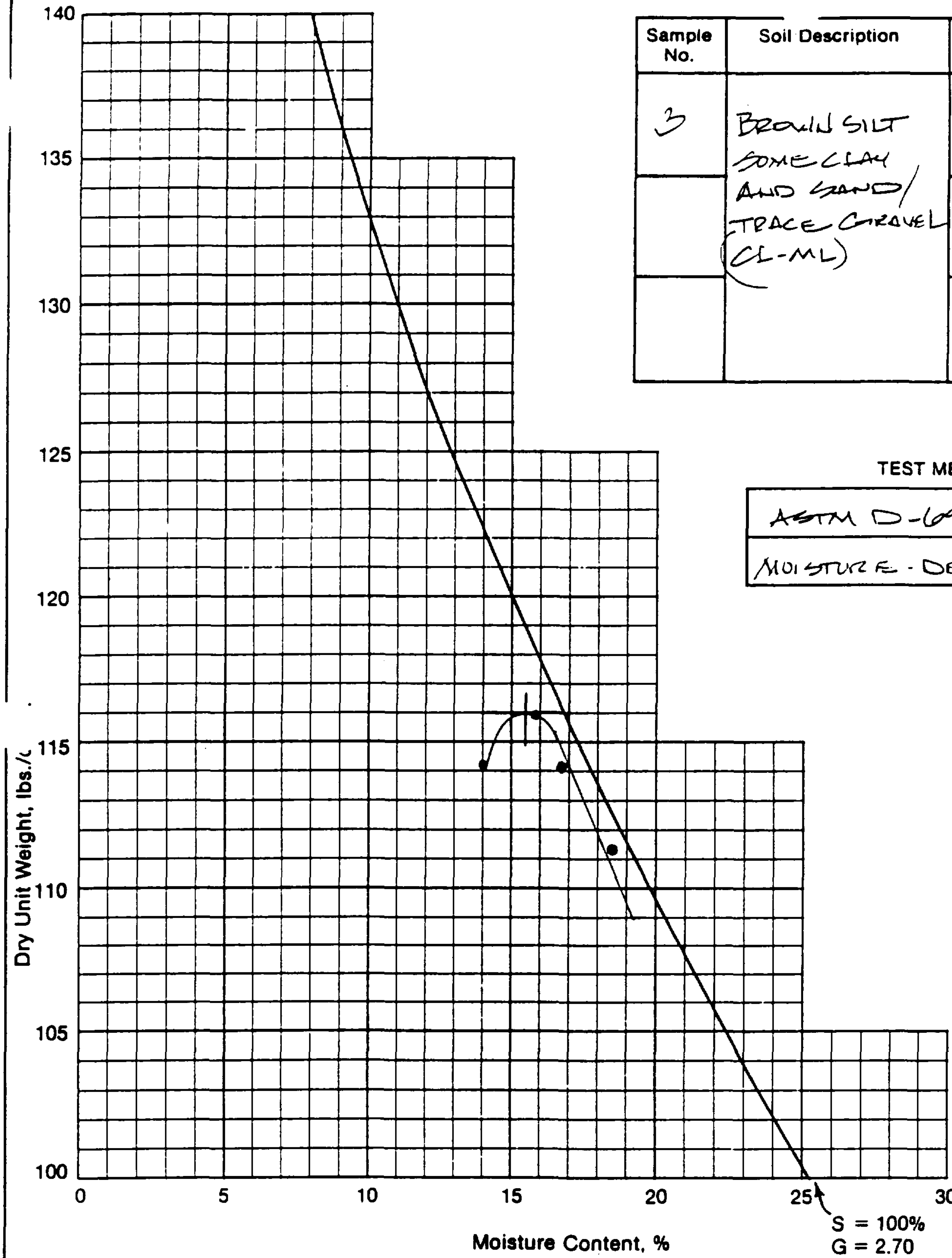
O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
C.K.P.	J.T.	8.30.90	89233

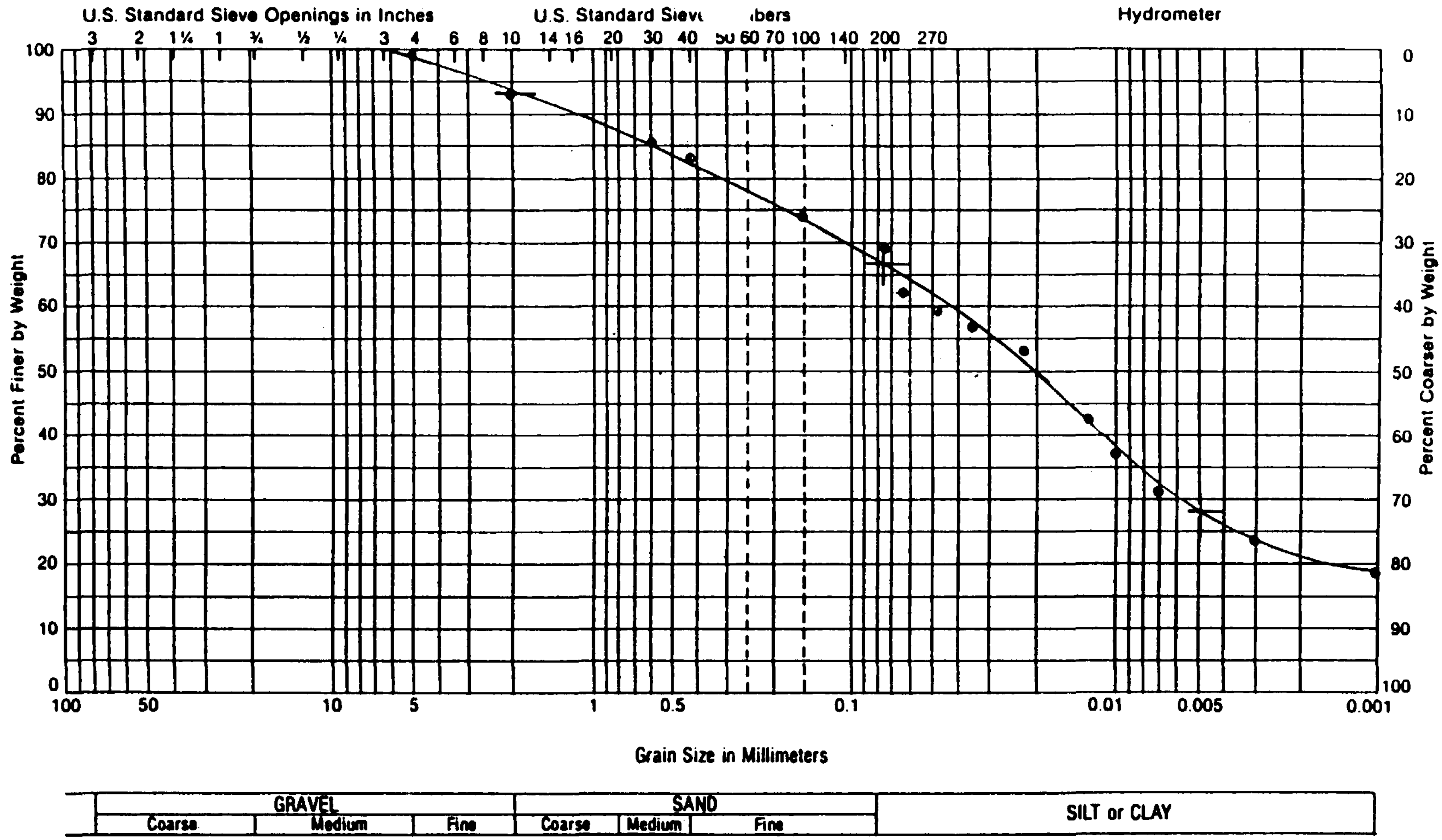
Sample No.	Soil Description	Max. Density	Optimum Mois.
3	BROWN SILT SOME CLAY AND SAND/ TRACE GRAVEL (CL-ML)	116.0	15.5

TEST METHOD

ASTM D-698 STANDARD
MOISTURE - DENSITY RELATIONS



MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKD
MANVILLE REMEDIAL WORK SOURCE: CENTRAL LAKE COUNTY WATER TREATMENT FACILITY (NORTH STOCKPILE ON SITE)	CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	APPROVED BY	J.P.
		DATE	8-21-90
		JOB NO.	89233

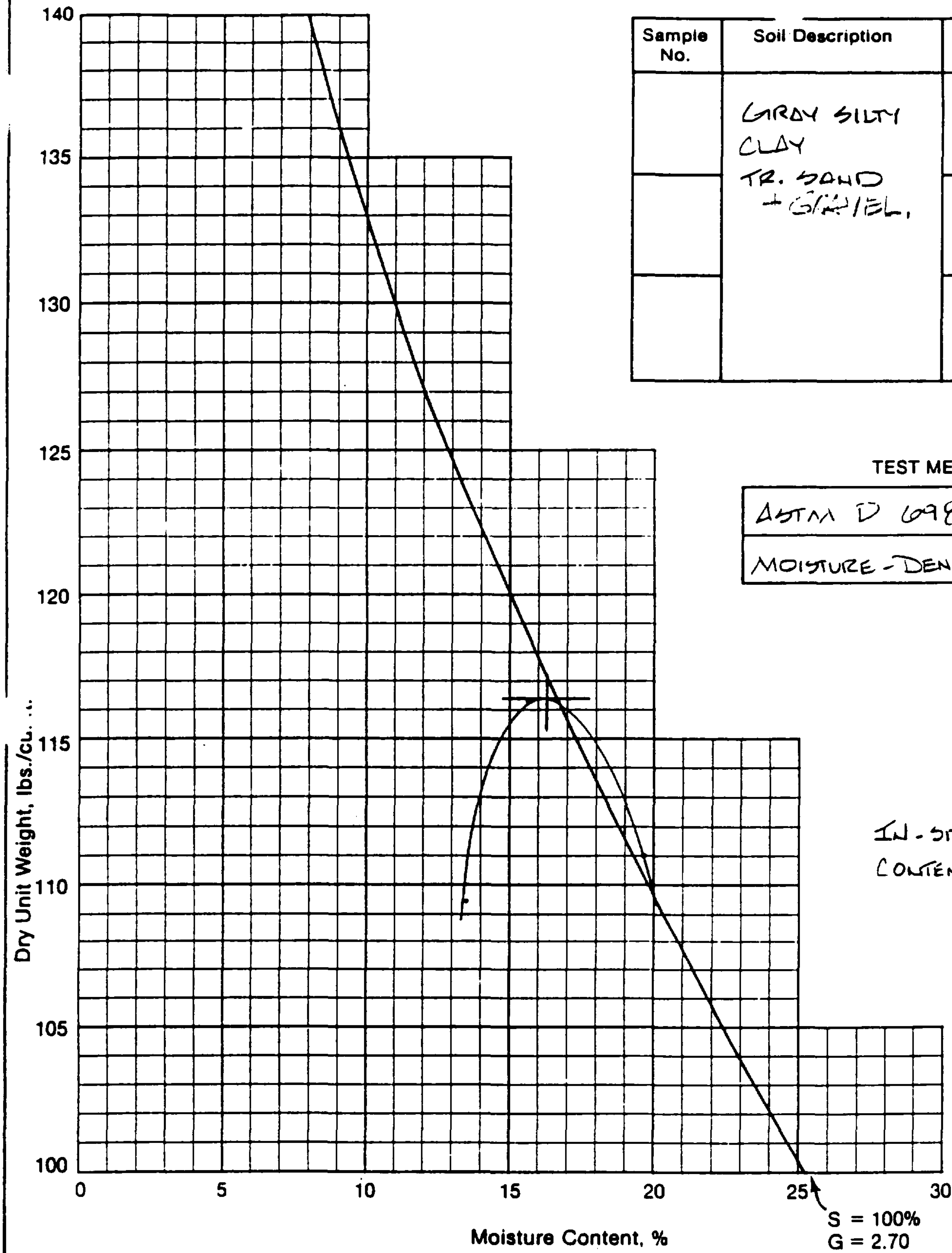


SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
#3		18	14	4	BROWN SILT (CL-ML)
					SOME CLAY AND SAND / TRACE GRAVEL
					39% SILT
					28% CLAY (0.005 mm)
					26% SAND
					7% GRAVEL

MANVILLE REMEDIAL WORK
SOURCE: CENTRAL LAKE COUNTY WATER TREATMENT FACILITY (NORTH STOCKPILE ON SITE)

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
C.K.D.	J.P.	3-30-90	89233



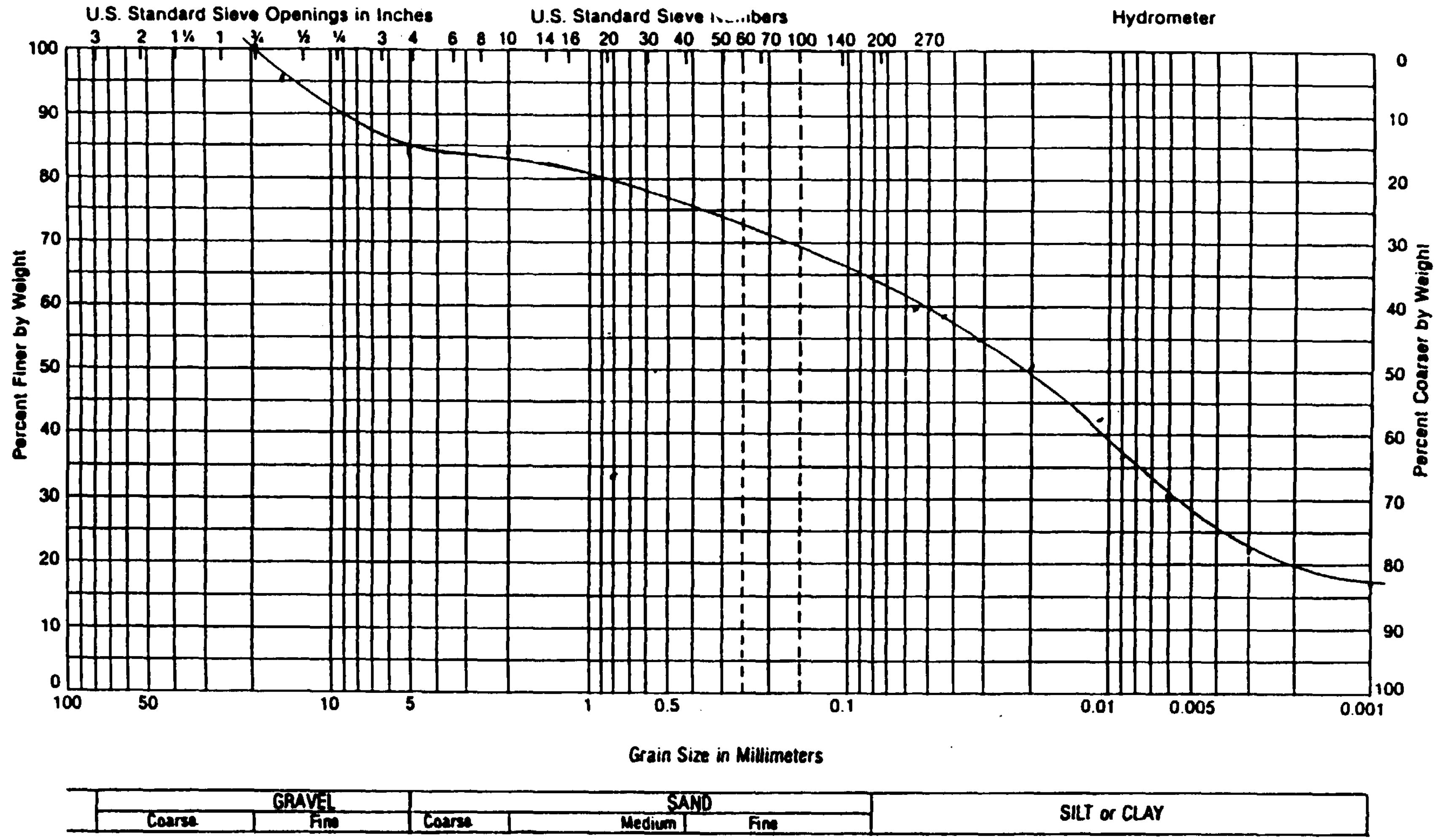
Sample No.	Soil Description	Max. Density	Optimum Mois.
	GRAY SILTY CLAY TR. SAND + GRAVEL.	116.5	16.3

TEST METHOD

ASTM D 698 (STANDARD)
MOISTURE-DENSITY RELATIONS

IN-SITU MOISTURE CONTENT = 15.4 %

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKP
SAMPLED FROM: WAUKEGAN WEST HIGH SCHOOL	CONSULTING ENGINEERS	APPROVED BY	JP
FOR: JOHN MANVILLE	P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS	DATE	2-20-91
WAUKEGAN, ILLINOIS	(312) 398-1441	JOB NO.	89293

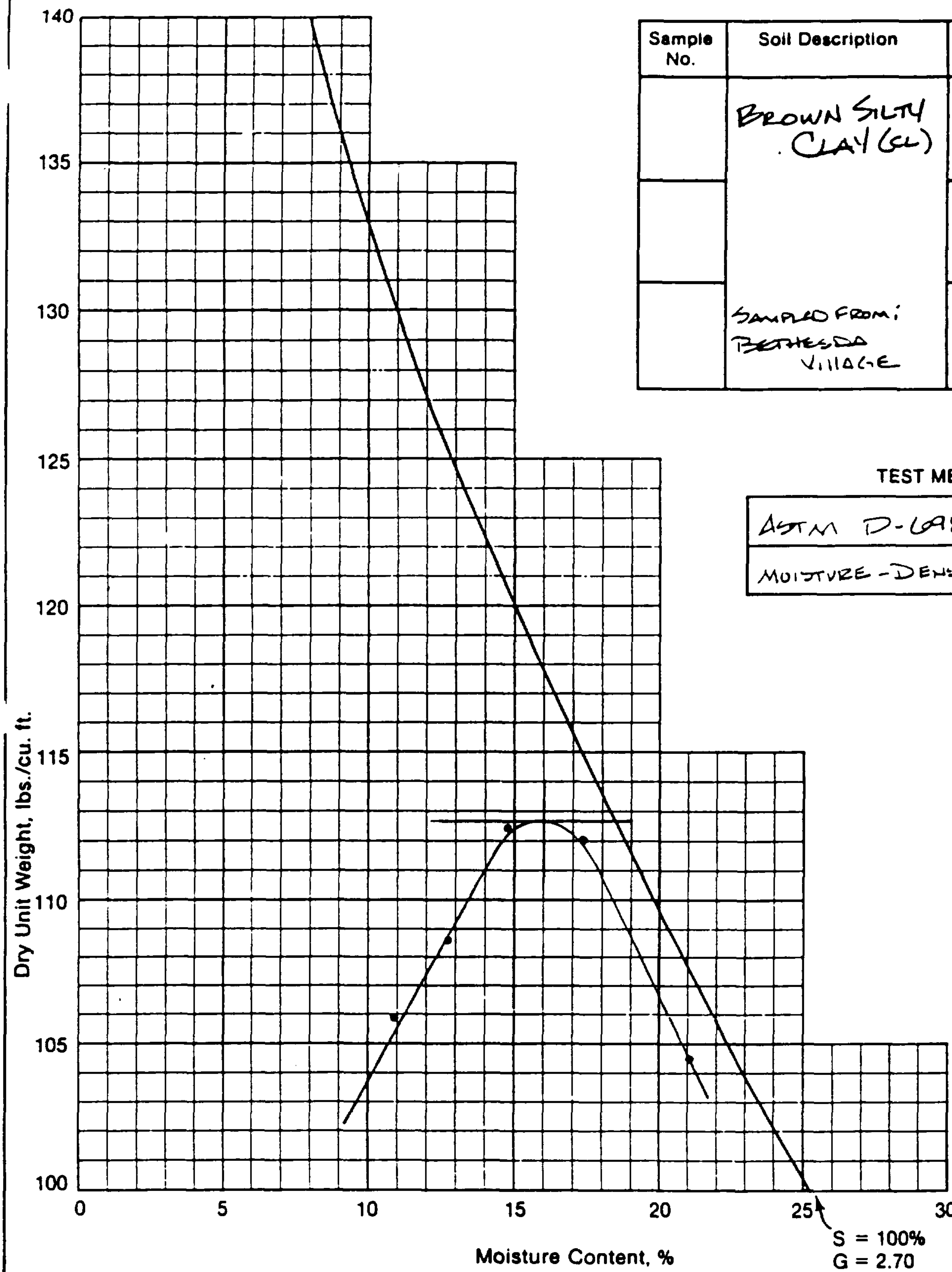


SAMPLE NO.	W.C.	LL	PL	PI	(UNIFIED) CLASSIFICATION
	15.4	22	15	7	GRAY SILTY CLAY w TR SAND +
					GRAVEL (CL)
					PH 8.2
					15% GRAVEL
					21% SAND
					36% SILT
					28% CLAY (0.005 MM)
					ORGANIC CONTENT 4.65%

MATERIAL SAMPLED FROM:
WAUKEGAN WEST HIGH SCHOOL

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
CKB	JP	2-20-91	89297

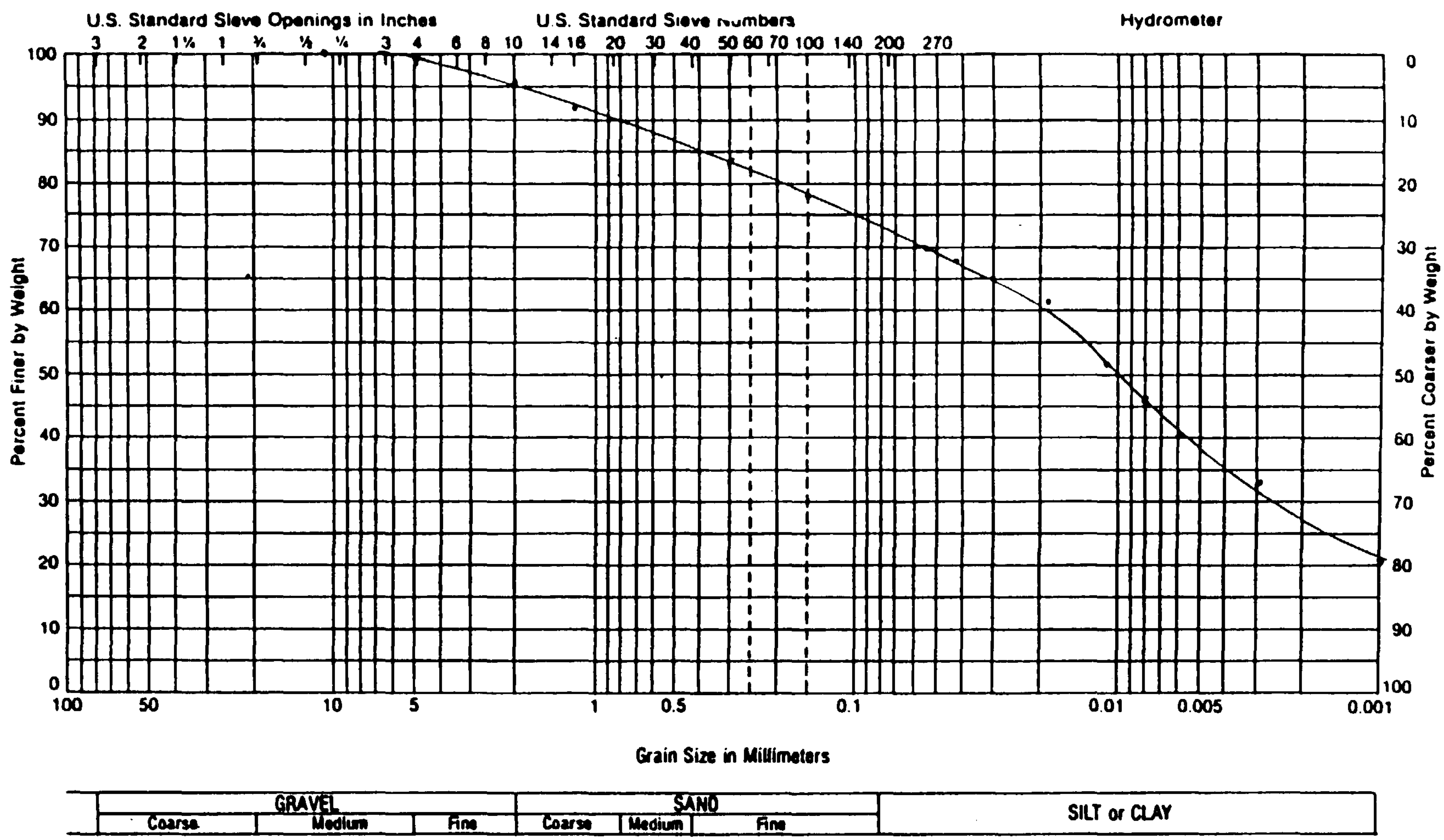


Sample No.	Soil Description	Max. Density	Optimum Mois.
	BROWN SILTY CLAY (CL)	112.7	16.0
	SAMPLED FROM: BETHESDA VILLAGE		

TEST METHOD

ASTM D-698 (STANDARD)
MOISTURE-DENSITY RELATIONS

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	CKB
JOHN MANVILLE WAUKEGAN, IL	CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	APPROVED BY	JP
		DATE	4-29-91
		JOB NO.	89293



SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
		28	17	11	BROWN SILTY CLAY (CL)
					pH 7.2
					ORGANIC CONTENT 3.0 %
					5% GRAVEL
					32% SAND
					63% SILT AND CLAY
					SAMPLED FROM: BETHESDA VILLAGE

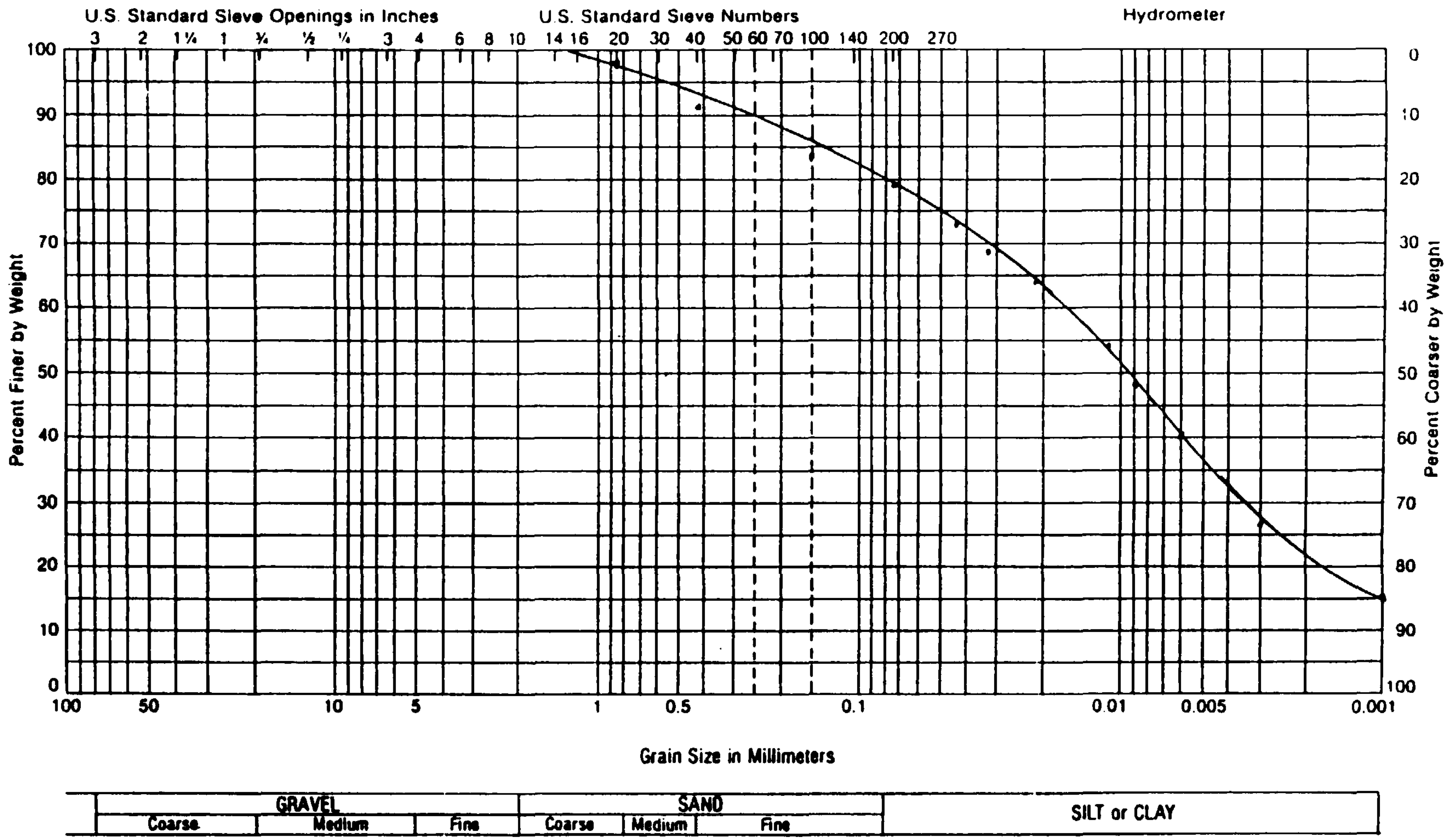
JOHN MANVILLE
WAUKEGAN, IL

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
CKD	J.P	4-29-91	89293

APPENDIX B-3

TOPSOIL



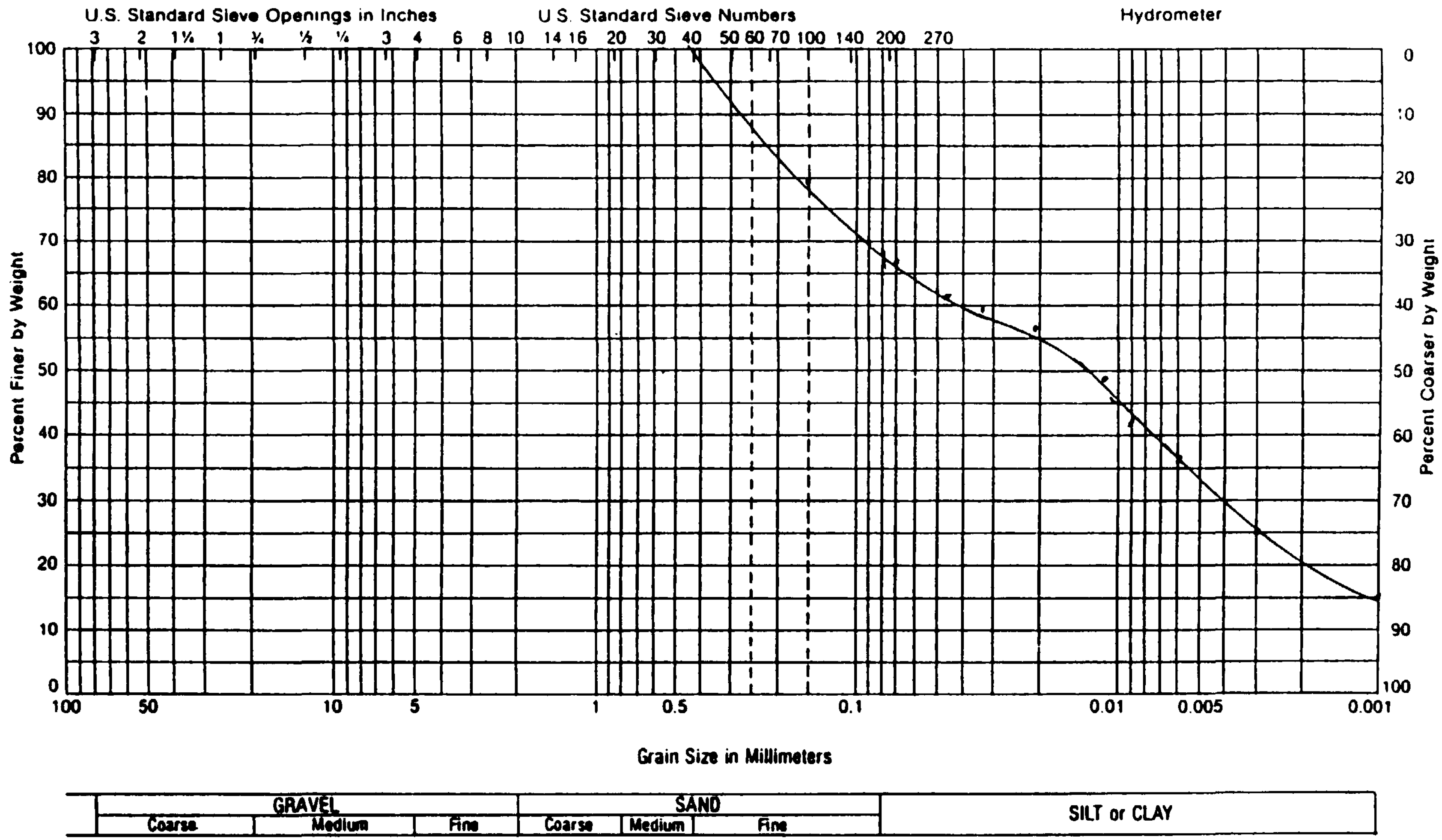
SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
		51%	26%	25	Black silty clay (CL ML)
		47%	26%	21	Some sand (Topsoil)
	(Average)	49%		23	
					36% clay (0.005 mm ϕ)
					44% silt
					20% sand
					Sampled From: Delaney · Sunset

Delaney & Sunset.
Manville Remedial Work
Waukegan, IL

Topsoil

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
CKB		11/17/89	89233



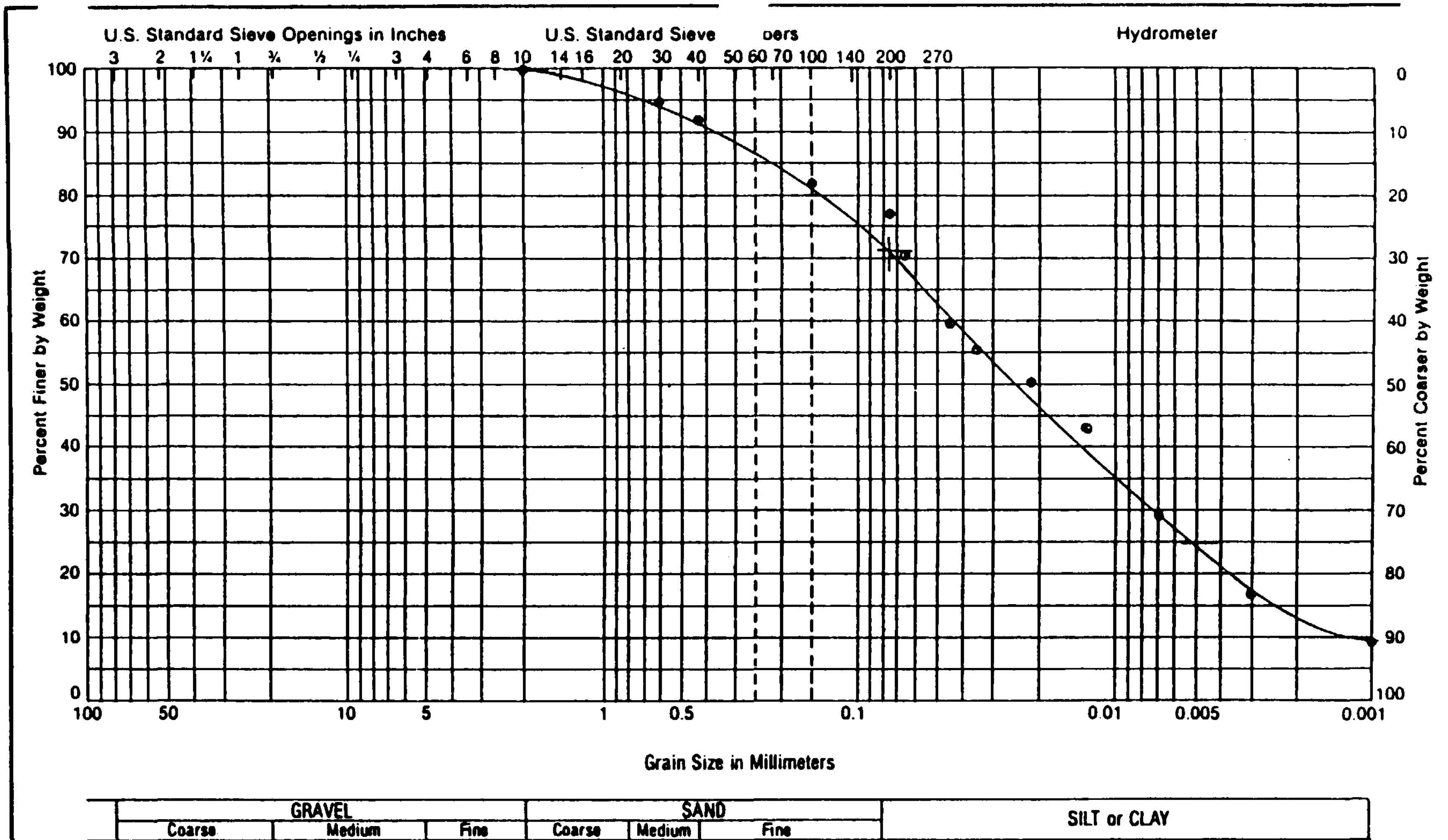
SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
		51%	28%	23	BLACK ORGANIC CLAY (CH-OH)
					SOME SILT AND SAND
					33%
					~~28~~% CLAY (0.005 MM ϕ)
					35% SILT
					32% SAND
					SAMPLED FROM: SKOKIE LAGOON

SKOKIE LAGOON
MANVILLE REMEDIAL WORK
WAUKEGAN, IL

~~[illegible]~~ TOPSOIL

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
CKB		11/17/89	89233

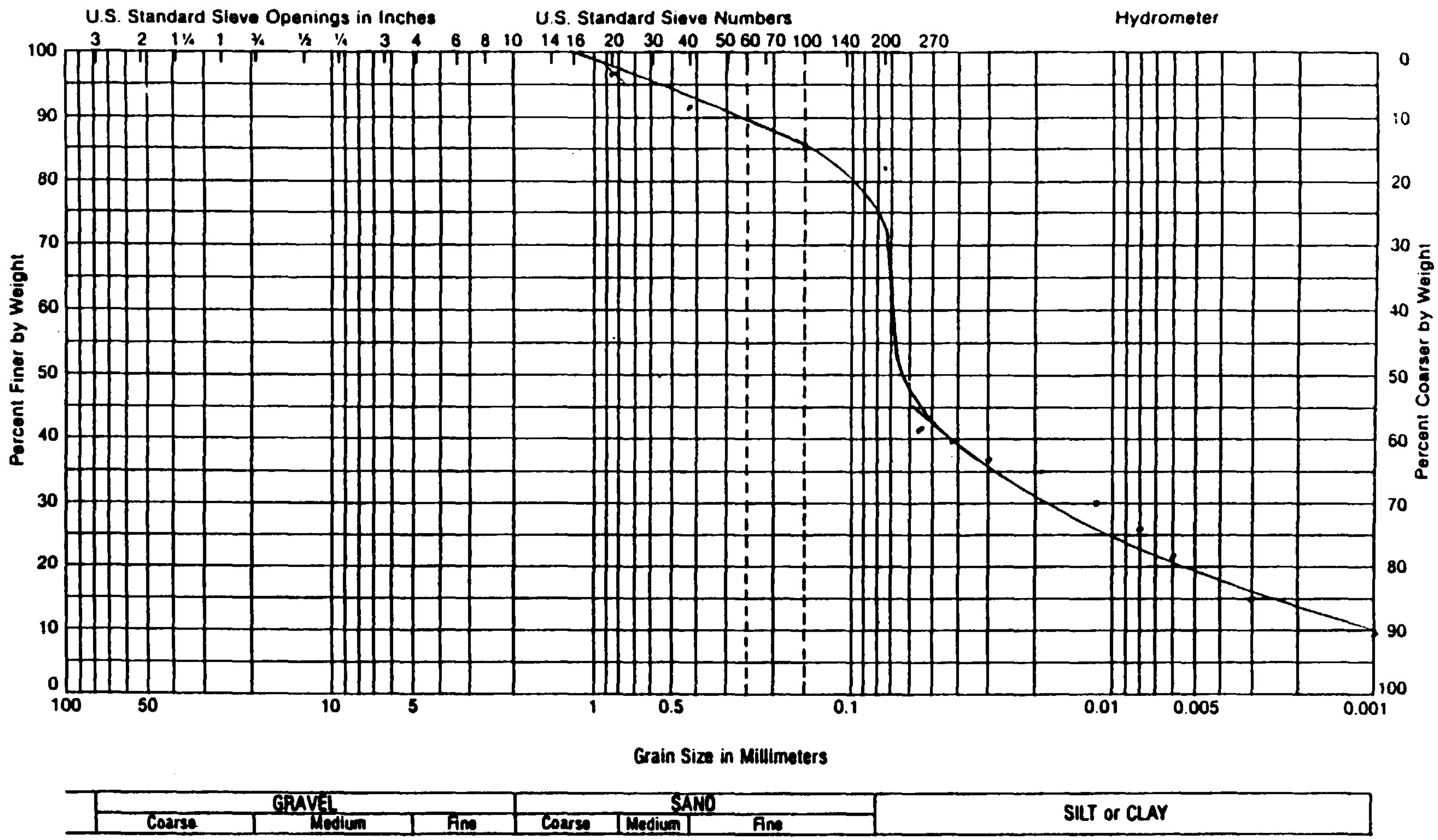


SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
#2		—	—	—	BLACK ORGANIC SILT (OL)
					SOME CLAY AND SAND (TOPSOIL)
					47 % SILT
					29 % SAND
					25% CLAY (0.005 MM)
					pH 6.0
					ORGANIC CONTENT 9 %

MANVILLE REMEDIAL WORK
SOURCE: CENTRAL LAKE COUNTY WATER TREATMENT FACILITY (STOCKPILE ON SITE)

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
CKB	J.P.	8-30-90	89233



SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
1		36.9	28.6	8.3	TOPSOIL - BLACK
					ORGANIC CLAY WITH SAND (ML-OL)
					25% SAND
					75% SILTY CLAY

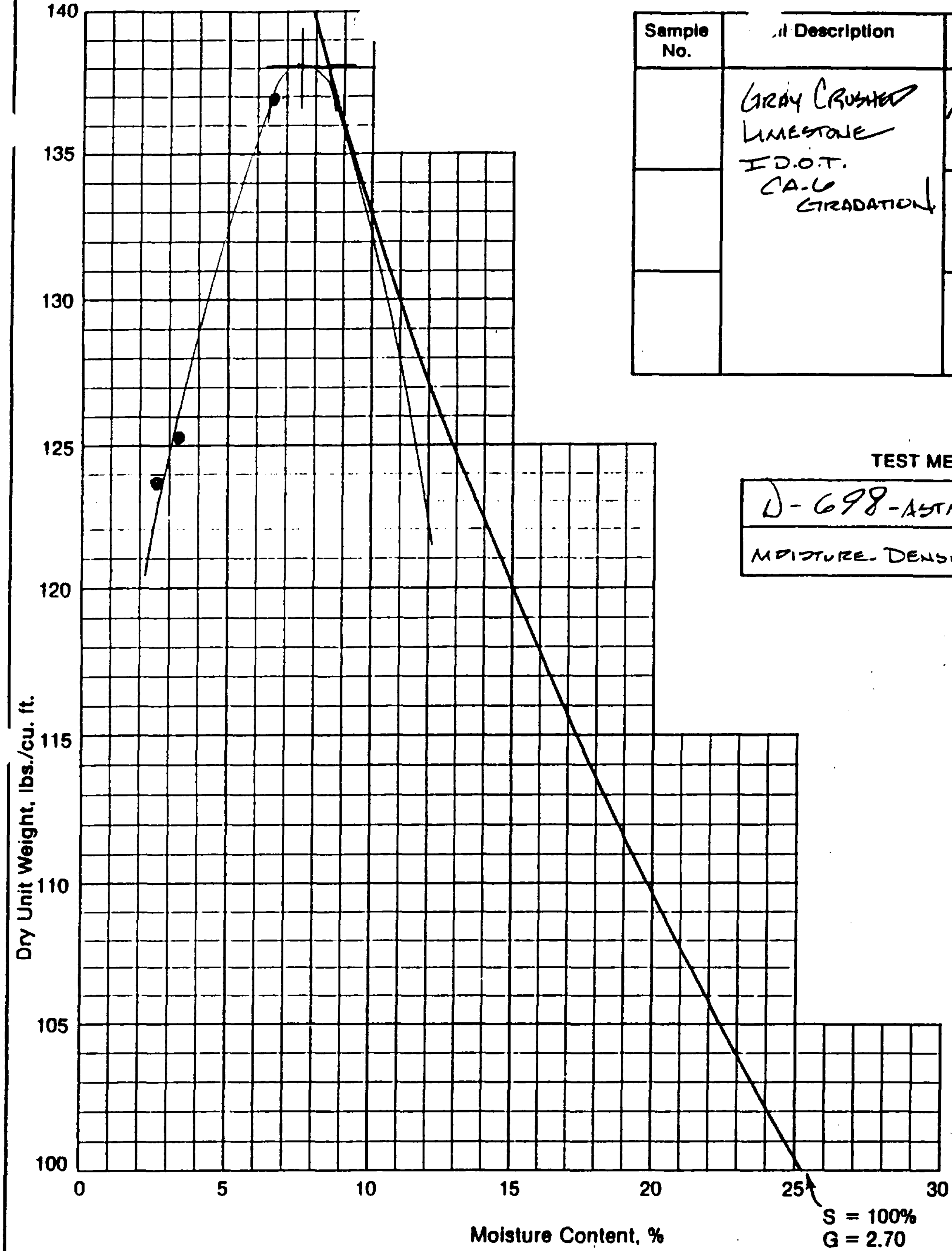
BETHESDA VILLAGE, ZION, IL

O'BRIEN & ASSOCIATES, INC.
P.O. BOX 1231 ARLINGTON HEIGHTS, IL

DRAWN	APPROVED	DATE	JOB No.
C.K.D.	J.P.	10-24-90	

APPENDIX B-4

GRAVEL



Sample No.	...il Description	Max. Density	Optimum Mois.
	Gray Crushed Limestone I.D.O.T. CA-6 Gradation	138.0	7.5%

TEST METHOD

D-698-ASTM-STANDARD
MOISTURE-DENSITY RELATIONS

MOISTURE DENSITY CURVE	O'BRIEN & ASSOCIATES, INC.	DRAWN BY	D.M.H.
Manville Remedial Work Waukegan, Illinois	CONSULTING ENGINEERS P.O. BOX 1231 ARLINGTON HEIGHTS, ILLINOIS (312) 398-1441	APPROVED BY	J.P.
		DATE	2/21/90
		JOB NO.	89293

APPENDIX C

O'BRIEN FIELD DENSITY TEST DATA

'BRIEN & ASSOCIATES, I
CONSULTING ENGINEERS

P.O. BOX 1231 • ARLINGTON HEIGHTS, ILLINOIS 60006 • (312) 398-1441

Job No. 89233

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location: Manville Remedial Work, Waukegan, IL.

Architect or Engineer: CRA, Ltd.

Contractor: Lake County Grading & Excavating Company

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☐ Nuclear Method
- ☐ ______

TEST NO.	1989 DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
1	6-8	NORTH WASTE PILE	GRADE	114.0*	10.5	104.5	91.6
2					10.5	103.8	91.0
3					11.3	104.9	92.0
4					11.5	105.5	92.5
5					12.0	103.9	91.1
6					11.1	105.2	92.2
7					11.0	103.5	90.7
8					11.3	105.3	92.5
9	6-9	NORTH WASTE PILE			11.3	106.0	92.9
10					10.9	105.6	92.5
11					11.9	104.5	91.6
12					11.8	103.6	90.8
13					12.0	108.3	95.0
14					12.4	104.5	91.6
15	6-20	NORTH WASTE PILE		113.0	14.3	103.6	91.6
16		10+125 TO WEST END			12.8	106.6	94.3
17					14.1	105.1	93.0
18					12.7	103.9	91.9
19					12.9	103.8	91.0
20					11.7	104.3	92.3
21					12.3	103.7	91.7
22					11.9	104.4	92.3
23	6-26	ABESTO PIT 11+300 TO			12.5	105.3	92.5
24		11+200			12.8	103.9	91.1
25					11.1	105.5	92.5
26					12.3	103.8	91.0

CRA/MANVILLE
WAUKEGAN, IL
JUL 20 1989
RECEIVED

* ESTIMATED.

'BRIEN & ASSOCIATES, IN
CONSULTING ENGINEERS

P.O. BOX 1231 • ARLINGTON HEIGHTS, ILLINOIS 60006 • (312) 398-1441

Job No. 89233

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Company

Method of Field Density Measurement
☐ Sand Cone Method
☐ Nuclear Method
☐ ______

TEST NO.	DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
27	6-26	ABESTO P.T 11+300 TO	GRADE	113.0	12.5	106.3	94.0
28		11+200			11.9	105.1	93.0
29					11.7	103.9	91.9
30					12.1	106.0	93.8
31	6-28	ABESTO P.T 11+200 TO 11+075			13.0	104.9	92.8
32					12.9	103.8	91.8
33					13.1	105.0	92.9
34					12.8	103.9	91.9
35					11.1	102.8	90.9
36					12.3	1061	93.8
37		SLOPE N. WASTE PILE			11.3	105.1	93.0
38		WEST SIDE NORTH OF RAMP			12.1	102.9	91.0
39					12.0	105.0	92.9
40					13.0	1046	92.5
41	7-5	NORTH WASTE PILE GOING			11.9	102.8	90.9
42		EAST 10+500 TO 10+625			11.7	108.3	95.8
43					12.6	105.5	93.4
44					13.4	103.8	91.8
45					12.9	104.9	92.8
46					11.8	104.4	92.3
47	7-7	NORTH WASTE PILE			12.3	105.3	93.1
48		NORTH EDGE TO ROAD TO			13.1	107.7	95.3
49		10+625			12.8	104.9	92.8
50					11.7	103.9	91.9
51					13.0	102.9	91.0
52					12.9	1055	93.4

( )RIEN & ASSOCIATES, IN(
CONSULTING ENGINEERS

P.O. BOX 1231 • ARLINGTON HEIGHTS, ILLINOIS 60006 • (312) 398-1441

Job No. 89233

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Company

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☐ Nuclear Method
- ☐ ____________

TEST NO.	DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
53	7-7	NORTH WASTE PILE	GRADE	113.0	12.0	103.6	91.6
54		NORTH EDGE TO ROAD TO			13.1	105.0	92.9
55		10+625			12.5	103.9	91.9
56	7-10	NORTH WASTE PILE			12.9	1028	90.9
57		9,300 TO 9,000 NORTH			12.7	106.1	93.8
58					13.0	103.8	91.8
59					12.6	105.1	93.0
60					12.8	104.8	92.7
61					11.9	103.9	91.9
62					13.1	105.5	93.3
63					12.3	103.8	91.8
64					13.0	102.9	91.0
65					12.6	1044	92.3
66	7-12	NORTH WASTE PILE			11.4	104.5	92.4
67		9000 NORTH TO 8575			13.3	103.6	91.6
68					13.1	1043	92.3
69					12.9	105.9	93.7
70					11.9	1043	92.3
71					11.3	106.6	94.3
72					12.6	104.9	92.8
73					13.1	102.8	90.9
74					13.0	105.5	93.3
75					14.3	1033	91.4

O'BRIEN & ASSOCIATES, INC
CONSULTING ENGINEERS

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Job No. 89233

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Company

Method of Field Density Measurement ☐ Sand Cone Method ☐ Nuclear Method ☐

TEST NO.	DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
76	7-14	NORTH WASTE PILE	GRADE	113.0	11.2	104.9	92.8
77		8575 TO 8550			13.5	102.6	90.7
78					13.4	105.5	93.3
79					12.9	108.3	95.8
80					13.1	104.5	92.4
81	7-18	NORTH WASTE PILE			12.3	108.5	96.0
82		8550 TO 8425 NORTH			12.5	104.4	92.3
83					11.9	107.1	94.7
84					13.4	105.3	93.1
85					12.6	103.9	91.9
86					13.9	102.7	90.8
87					13.5	106.6	94.3
88					12.3	103.8	91.9
89					11.9	102.9	91.0
90					13.5	106.5	94.2
91					12.3	107.5	95.1
92	7-25	NORTH WASTE PILE			13.4	105.9	93.4
93		8425 NORTH TO WEST SLOPE			13.3	106.6	94.3
94					12.8	103.5	91.5
95					11.2	103.3	91.4
96					12.9	102.7	90.8
97					12.6	104.4	92.3
98					13.3	107.1	94.7
99					12.8	103.4	91.5
100					12.6	105.7	93.5

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Job No. 89233

SUMMARY OF FIELD DENSITY TEST RESULTS

CRA/MANVILLE
WAUKEGAN, IL
NOV 1 1989
RECEIVED

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Company

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☐ Nuclear Method
- ☐ ____________

TEST NO.	DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
101	8-2	NORTH, WASTE PILE	GRADE	113.0	10.6	107.3	94.9
102		NORTH SLOPE			13.3	102.8	90.9
103					12.1	103.6	91.6
104					14.8	105.9	93.7
105					10.9	105.5	93.3
106	8-8	NORTH WASTE PILE			12.6	109.5	96.9
107		9400 TO 8300			11.8	106.6	94.3
108					12.3	103.5	91.5
109					11.3	103.9	91.9
110					12.1	110.5	97.7
111					13.6	102.9	91.0
112					12.5	103.1	91.2
113					14.3	102.8	90.9
114					12.3	105.3	93.1
115					10.9	104.1	92.1
116					11.1	105.6	93.4
117	8-16	BALANCE NORTHWASTE PILE			12.6	102.5	90.7
118					11.9	106.3	94.0
119					13.3	104.1	92.1
120					12.9	105.3	93.1
121					11.5	102.6	90.7
122					13.5	103.5	91.5
123					12.3	106.6	94.3
124					11.8	105.9	93.7
125					11.0	104.8	92.7
126					12.0	103.9	91.9

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Job No. 89233

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Company

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☐ Nuclear Method
- ☐ ______

TEST NO.	DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
127	8-18	SOUTH CENTRAL AREA "E"	GRADE	113.0	10.7	107.1	94.7
128		11+700 TO 12+100 EAST			12.5	108.3	95.8
129		8000 TO 8+200 NORTH			13.6	104.4	92.3
130					11.9	106.3	94.0
131					10.9	102.7	90.8
132					12.3	103.5	91.5
133					10.8	105.1	93.0
134					13.3	105.4	93.2
135		SOUTH BORDER 11200 TO			12.1	103.9	91.9
136		11500 EAST 7500 TO 8300 N.			14.0	102.9	91.0
137					13.5	105.3	93.1
138					13.3	103.8	91.8
139					12.4	105.1	93.0
140					11.6	106.5	94.2
141					10.9	107.6	95.2
142					12.3	103.3	91.4
143					14.1	102.9	91.0
144	8-21	SOUTH CENTRAL AREA "E"			12.6	106.5	94.2
145		7900 TO 8000 NORTH			12.9	105.3	93.1
146		12100 TO 12300 EAST			11.3	107.0	94.6
147					12.3	103.5	91.5
148					12.5	104.4	92.3
150					11.8	106.1	93.8
151					12.6	106.0	93.8
152					11.9	105.1	93.0
153					10.7	104.9	92.8

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Job No. 89233

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Company

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☐ Nuclear Method
- ☐

TEST NO.	DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
154	8-23	SOUTH CENTRAL AREA "E"	GRADE	113.0	10.8	103.4	91.5
155		7800 NORTH TO 8000 NORTH			12.3	105.1	93.0
156		12300 EAST TO 12500 EAST			12.9	106.6	94.3
157					10.8	107.5	95.1
158					13.1	103.9	91.9
159					12.5	102.9	91.0
160					11.6	106.3	94.0
161					10.8	104.3	92.3
162	8-25	SOUTH CENTRAL AREA E			14.3	105.0	92.9
163		8000 TO 7800 NORTH			12.1	106.1	93.8
164		12500 TO 12900 EAST			12.9	102.7	90.9
165					13.0	102.6	90.7
166					14.0	107.7	95.3
167					13.5	103.6	91.6
168					12.6	105.1	93.0
169					11.9	105.0	92.9
170					11.5	107.8	95.3
171	8-25	SOUTH BORDER			10.9	102.9	91.0
172		7500 TO 7900 NORTH			12.3	103.6	91.6
173		11500 TO 11900 EAST			12.5	107.7	95.3
174					11.0	108.3	98.0
175					11.1	105.5	93.3
176					13.4	106.3	94.0
177					14.1	104.2	92.2
178					12.3	104.5	92.4
179					11.6	103.6	91.6

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CONSULTING ENGINEERS

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Job No. 89293

SUMMARY OF FIELD DENSITY TEST RESULTS

CRA/MANVILLE
WAUKEGAN, IL
DEC 5 1989
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Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Company

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☐ Nuclear Method
- ☐

TEST NO.	~~DATE~~ Lift	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
180	~~9-18~~	SOUTH CENTRAL "E"	GRADE	113.0	12.1	105.3	93.1
181		VARIOUS LOCATIONS			11.3	106.1	93.8
182					11.5	102.7	90.8
183					12.4	103.7	91.7
184					12.9	105.5	93.3
185					11.9	102.9	91.0
186					14.0	106.6	94.3
187					13.1	103.3	91.4
188	9-20	SOUTH BORDER			15.0	105.1	93.0
189		SOUTH SLOPE			13.9	103.8	91.8
190					14.1	106.5	94.2
191					13.3	105.5	93.3
192					11.5	103.5	91.5
193					11.8	102.8	90.9
194					11.5	105.1	92.9
195	9-25	SOUTH BORDER 7500 NORTH			12.3	104.4	92.3
196		TO EAST [illegible] 12800 EAST			11.9	106.6	94.3
197					12.0	103.9	91.9
198					13.5	105.0	92.9
199					12.6	103.4	91.5
200					11.9	103.9	91.9
201					13.5	102.9	91.0
202					12.9	104.5	92.0
203					12.0	106.1	93.8
204					13.6	105.4	93.2
205					12.3	105.0	92.9

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CONSULTING ENGINEERS

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Job No. 89293

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location: Manville Remedial Work, Waukegan, IL

Architect or Engineer: CRA, Ltd.

Contractor: Lake County Grading & Excavating Company

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☐ Nuclear Method
- ☐ ____________

TEST NO.	DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
206	9-27	SOUTH BORDER 7600 TO 8000 N	GRADE	113.0	12.6	106.3	94.0
207		& 12900 TO 13100 EAST			13.1	102.9	91.0
208					[illegible]	107.7	95.3
209					12.9	105.1	93.0
210					11.3	104.3	92.3
211					13.3	106.5	94.2
212					12.1	102.8	90.7
213					13.4	103.0	91.1
214					12.6	107.1	94.7
215	9-27	SOUTH CENTRAL AREA "E"			11.5	106.1	93.8
216		8000 TO 8100 NORTH &			13.3	103.9	91.9
217		12200 TO 12400 EAST			14.1	105.1	93.0
218					11.9	107.5	95.1
219					13.1	105.6	93.4
220					13.5	104.9	92.8
221					12.9	107.5	95.1
222					12.8	104.8	92.7
223	10-2	SOUTH CENTRAL AREA "E"			11.6	105.5	93.5
224		12400 TO 12700 EAST &			13.1	107.1	94.7
225		8000 TO 8100 NORTH			11.9	109.5	96.9
226					10.4	106.3	94.0
227					11.9	104.1	92.1
228					12.3	102.8	90.9
229					12.5	105.5	93.5
230					13.5	106.5	94.2
231					11.6	103.3	91.4

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O'BRIEN & ASSOCIATES INC.
CONSULTING ENGINEERS

P.O. BOX 1231 • ARLINGTON HEIGHTS, ILLINOIS 60006 • (312) 398-1441

Job No. 89293

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Company

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☐ Nuclear Method
- ☐ ____________

TEST NO.	DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
232	10-4	SOUTH CENTRAL AREA "E"	GRADE	113.0	11.5	108.1	95.6
233		12700 TO 13000 EAST ℄			13.6	103.3	91.4
234		8100 TO 8000 NORTH			11.9	105.1	93.0
235					11.8	109.4	96.8
236					13.5	102.9	91.0
237					12.1	106.1	93.8
238					13.4	103.9	91.9
239					12.9	104.4	92.3
240					13.8	101.9	90.1
241	10-9	SOUTH CENTRAL AREA "E"			13.9	[illegible]	95.1
242		12700 TO 12900 EAST ℄			12.9	[illegible]	90.9
243		8100 TO 8000 NORTH			12.8	101.8	90.0
244					10.9	106.5	94.2
245					12.6	103.5	91.5
246					13.1	106.1	93.8
247					12.0	104.9	92.8
248					10.8	103.5	91.5
249	10-11	EAST BORDER AREA			12.7	106.1	93.8
250		9675 TO 10000 NORTH ℄			13.3	107.7	95.3
251		13250 TO 13900 EAST			12.5	108.5	96.0
252					13.1	101.9	90.1
253					14.1	106.5	94.2
254					13.5	101.8	90.0
255					13.0	102.5	90.7
256					12.1	101.9	90.1
257					13.3	106.6	94.3

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CONSULTING ENGINEERS

P.O. BOX 1231 • ARLINGTON HEIGHTS, ILLINOIS 60006 • (312) 398-1441

Job No. 89293

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location: Manville Remedial Work, Waukegan, IL

Architect or Engineer: CRA, Ltd.

Contractor: Lake County Grading & Excavating Company

Method of Field Density Measurement: ☐ Sand Cone Method ☐ Nuclear Method ☐ ________

TEST NO.	DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
258	10-25	SOUTH CENTRAL AREA "W"	GRADE	113.0	11.9	106.1	93.8
259		7750 TO 8000 NORTH &			13.6	104.3	92.3
260		1075 TO 11000 EAST			13.0	102.9	91.0
261					13.5	101.7	90.0
262					12.6	103.9	91.9
263					13.1	106.0	93.8
264					11.5	107.5	95.1
265					13.8	109.3	96.7
266	10-27	FUTURE MISC WASTE DISPOSAL			13.9	102.6	90.7
267		8200 TO 8300 NORTH &			14.0	106.5	94.2
268		11300 TO 11400 EAST			13.6	101.9	90.1
269					13.1	105.3	93.1
270					12.5	106.4	94.1
271					12.9	103.3	91.4
272					11.8	102.7	90.8
273					12.6	105.4	93.2
274	10-30	SOUTH CENTRAL AREA "W"			10.5	108.0	95.5
275		8050 TO 7750 NORTH &			12.7	103.6	[illegible]
276		11100 TO 11200 EAST			12.5	107.7	95.3
277					13.6	103.8	[illegible]
278					12.5	106.0	93.8
279					13.0	104.3	92.3
280					13.3	103.5	91.5
281					10.5	108.1	95.6
282					13.0	102.5	[illegible]
283					14.3	101.9	90.1

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O'BRIEN & ASSOCIATES, INC.
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P.O. BOX 1231 ● ARLINGTON HEIGHTS, ILLINOIS 60006 ● (312) 398-1441

Job No. 89233

SUMMARY OF FIELD DENSITY TEST RESULTS

CRA/MANVILLE
WAUKEGAN, IL

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd. MAY 1 1 1990

Contractor Lake County Grading & Excavating Company

RECEIVED

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☐ Nuclear Method
- ☐ ______

TEST NO.	DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
180	4-30	BASIN #7	GRADE	114.0	11.2	107.6	95.2
181					11.6	105.9	93.2
182					10.9	104.2	92.2
183		BASIN # 2 & 8			16.2	108.3	95.0
184					8.9	103.3	91.4
185					12.7	105.1	93.0
186		NORTH ROAD (STONE)		138.0	3.7	131.4	95.2
187					3.9	131.0	95.0
188					3.6	132.6	96.1
189		MIDDLE ROAD			4.3	131.3	95.1
190					3.1	135.6	98.2
191					3.0	134.2	97.7
192		SOUTH ROAD			3.8	131.2	95.0
193					2.7	131.4	96.6
194					2.4	131.3	95.5
195		BASIN #7		114.0	11.2	105.6	93.4
196					11.6	103.5	91.5
197					10.5	107.4	95.0

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Job No: 89233

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location: Manville Remedial Work, Waukegan, IL

Architect or Engineer: CRA, Ltd.

Contractor: Lake County Grading & Excavating Company

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☐ Nuclear Method
- ☐ ______________

TEST NO.	90 DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
284	5-30	NORTH ROAD STONE	GRADE	136.0	4.6	130.3	95.8
285					6.0	129.8	95.4
286					6.1	132.3	97.2
287					4.9	132.9	97.7
288					5.5	133.9	98.4
289		SOUTH ROAD STONE			5.0	136.0	100.0
290					4.7	129.7	95.3
291					5.9	132.5	97.4
292					5.2	133.9	98.4
293					4.8	131.0	96.3
294					6.0	134.2	98.6
295		SLOPES MISC DISPOSAL PIT	GRADE	113.0		103.9	91.9
296						101.9	90.1
297						107.6	95.2
298						105.9	93.7
299						101.7	90.0
300	10-8	BALANCE EAST ROAD STONE	GRADE	136.0	4.7	133.0	97.7
301					5.9	136.0	100.0
302					4.9	129.6	95.3
303					6.0	136.0	100.0
304					5.7	134.5	98.8
305		PARKING LOT N.W. CORNER			5.5	131.9	96.9
306					4.8	130.7	96.1
307					6.0	134.5	98.8
308					5.7	130.7	96.1
309					5.5	133.5	98.1

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P.O. BOX 1231 • ARLINGTON HEIGHTS, ILLINOIS 60006 • (312) 398-1441

Job No. 89233

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Company

Method of Field Density Measurement ☐ Sand Cone Method ☐ Nuclear Method ☐ ________

TEST NO.	190 DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
310	12-11	PARKING LOT EAST OF	GRADE	136.0	4.9	130.3	95.8
311		RAILROAD TRACKS			4.7	129.2	95.0
312					5.0	130.6	96.0
313					5.5	133.9	98.4
314					4.8	129.8	95.4
315					5.3	131.6	96.7
316					5.6	134.3	98.7
317					5.9	132.2	97.2
318					4.7	133.9	98.4
319					5.1	134.0	98.5
320					5.4	131.6	96.7
321	5.22.91	ROADS AROUND SAND BORROW PIT			5.6	132.9	97.7
322		WEST, NORTH & EAST			5.9	130.5	95.9
323					4.4	133.9	98.4
324					5.0	136.0	100.0
325					5.7	130.8	96.1
326					4.9	131.9	96.9
327					4.8	134.3	98.7
328					4.5	133.9	98.4
329					5.0	132.7	97.5
330					5.5	133.6	98.2
331					4.8	136.0	100.0
332		CLAY ROADS EAST PIT		113.0	10.8	104.6	92.5
333					12.8	107.3	94.9
334					10.9	108.9	96.3
335					13.1	105.4	93.2

#14

O'BRIEN & ASSOCIATES, INC.
CONSULTING ENGINEERS

P. O. BOX 1231 • ARLINGTON HEIGHTS, ILLINOIS 60006 • (708) 398-1441

Job No. 89293

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Co.

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☑ Nuclear Method
- ☐

TEST NO	"91" DATE	LOCATION	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION
336	5-22	CLAY ROADS EAST P.T	GRADE	113.0	11.6	105.4	93.2
337					10.9	101.9	90.1
338					11.8	106.3	94.0
339					10.8	107.7	95.3
340					12.7	104.8	92.7
341	7-26	AREA Z SOUTH OF			9.7	106.0	93.9
342		PUMPING LAGOON			9 8	104.9	92.8
343					10 9	105.2	93.1
344					9.6	112.5	99.6
345					7.1	113.0	100.0
346	8-15	AREA Y & AREA Z		136.0	3 3	134 1	98.6
347					3.3	136.0	100.0
348					2 8	129 8	95 4
349					3 3	128.9	95.0
350					3.9	129.6	95.2
351					3.2	132.7	97.5
352					2.4	130 3	95 6
353					2.1	131 3	96.5
354					3 5	129.5	95.2
355					3 9	130.6	96.0
356					3.6	136 0	100.0
357					2 9	129.3	95.0
358					4.6	133 9	98.4
359					4.8	130 7	95.1
360					5.0	131.4	96 6
					4.9	129.3	95 0

#15

O'BRIEN & ASSOCIATES, INC.
CONSULTING ENGINEERS

P. O. BOX 1231 • ARLINGTON HEIGHTS, ILLINOIS 60006 • (708) 398-1441

Job No. 89293

SUMMARY OF FIELD DENSITY TEST RESULTS

Job Name and Location Manville Remedial Work, Waukegan, IL

Architect or Engineer CRA, Ltd.

Contractor Lake County Grading & Excavating Co.

Method of Field Density Measurement
- ☐ Sand Cone Method
- ☑ Nuclear Method
- ☐

TEST NO	"91" DATE	SURFACE LOCATION ASPHALT	GRADE OR ELEVATION	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PERCENT COMPACTION
361	8-20	AREA Y & AREA Z	GRADE	156.6		148.8	95.0
362						151.3	96.6
363						149.2	95.2
364						148.7	95.0
365						150.3	95.9
366						151.9	96.9
367						149.6	95.5
368						150.2	95.9
369						152.9	97.6
370						148.8	95.0

APPENDIX D

O'BRIEN CONCRETE COMPRESSIVE STRENGTH TEST DATA

O'BRIEN & ASSOCIATES, INC.
CONSULTING ENGINEER
P O BOX 1231 · ARLINGTON HEIGHTS, ILLINOIS 60006 · (312) 398-1441

COMPRESSIVE STRENGTH TEST RESULTS

Job Name and Location: Manville Remedial Work, Waukegan, IL.

Architect or Engineer: CRA, Ltd.

Contractor: Lake County Grading & Excavating Company

Project No.:

Job No. 89233

Test No.	Location	Date Made	Date Tested	Age (Days)	Strength (PSI)	Req'd Strength At 28 Days—PSI	Field Data, Remarks
1	BOX CULVERT	6-20	6-27	7	4850	4000	
2			7-18	28	5770		
3			7-18	28	5510		

CRA/MANVILLE
WAUKEGAN, IL
JUL 20 1989
RECEIVED

NOTE: Specimen is cylinder type with 28.3 sq. in. cross sectional area unless otherwise noted.

APPENDIX E

HEALTH AND SAFETY PLAN

ATTACHMENT G

HEALTH AND SAFETY PLAN

FOR

REMEDIAL ACTION

AT

JOHNS-MANVILLE DISPOSAL AREA
MANVILLE SALES CORPORATION
WAUKEGAN, ILLINOIS

JUNE 1988

(Revised September, 1988)

JOHNSON & MALHOTRA, P.C.
ENVIRONMENTAL ENGINEERS

GRAND RAPIDS, MICHIGAN

SITE HEALTH & SAFETY PLAN

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ATTACHMENT G

SITE HEALTH & SAFETY PLAN

Including

DECONTAMINATION PROCEDURES

The health and safety guidelines in this plan were prepared specifically for this site and should not be used on any other site without prior research and evaluation by trained health and safety specialists. Nothing in this plan shall relieve the contractor/consultant of any obligation to comply with applicable Federal, State and Local regulations.

HEALTH AND SAFETY PLAN

FOR THE

REMEDIAL ACTION
AT
JOHNS-MANVILLE DISPOSAL AREA

WAUKEGAN, ILLINOIS

Signatures

Brad Bradley U.S. EPA Remedial Project Manager (RPM)	Marvin Clumpus, P.E. Manville Sales Corporation Project Coordinator

Manville Remedial Construction
Manager (RCM)

SITE HEALTH AND SAFETY PLAN

1.0 INTRODUCTION

1.1 Site Location and Description

The Manville Sales Corporation (Manville), formerly Johns-Manville Sales Corporation, operates a manufacturing waste disposal area adjacent to its manufacturing plant site located in Waukegan, Illinois. The Disposal Area covers approximately 120 acres of the 300+ acres owned by Manville. The Disposal Area consists of currently active solid waste disposal areas, process wastewater treatment areas and inactive waste disposal area, as shown in Figure G-1.

1.2 Site History

Process and product related materials generated since 1922 have been disposed of in the Disposal Area. The wastes disposed of are primarily cuttings and waste products from manufacturing of asbestos-cement, roofing and insulating products. Wastes containing friable and non-friable asbestos were used to form portions of the dikes of the process wastewater treatment basins. Also, other inactive waste disposal areas are believed to have received sludges and waste materials containing asbestos, and trace amounts of lead and chromium in their oxidized form. All wastes known to contain friable asbestos have been disposed of properly in the Asbestos Disposal Pit.

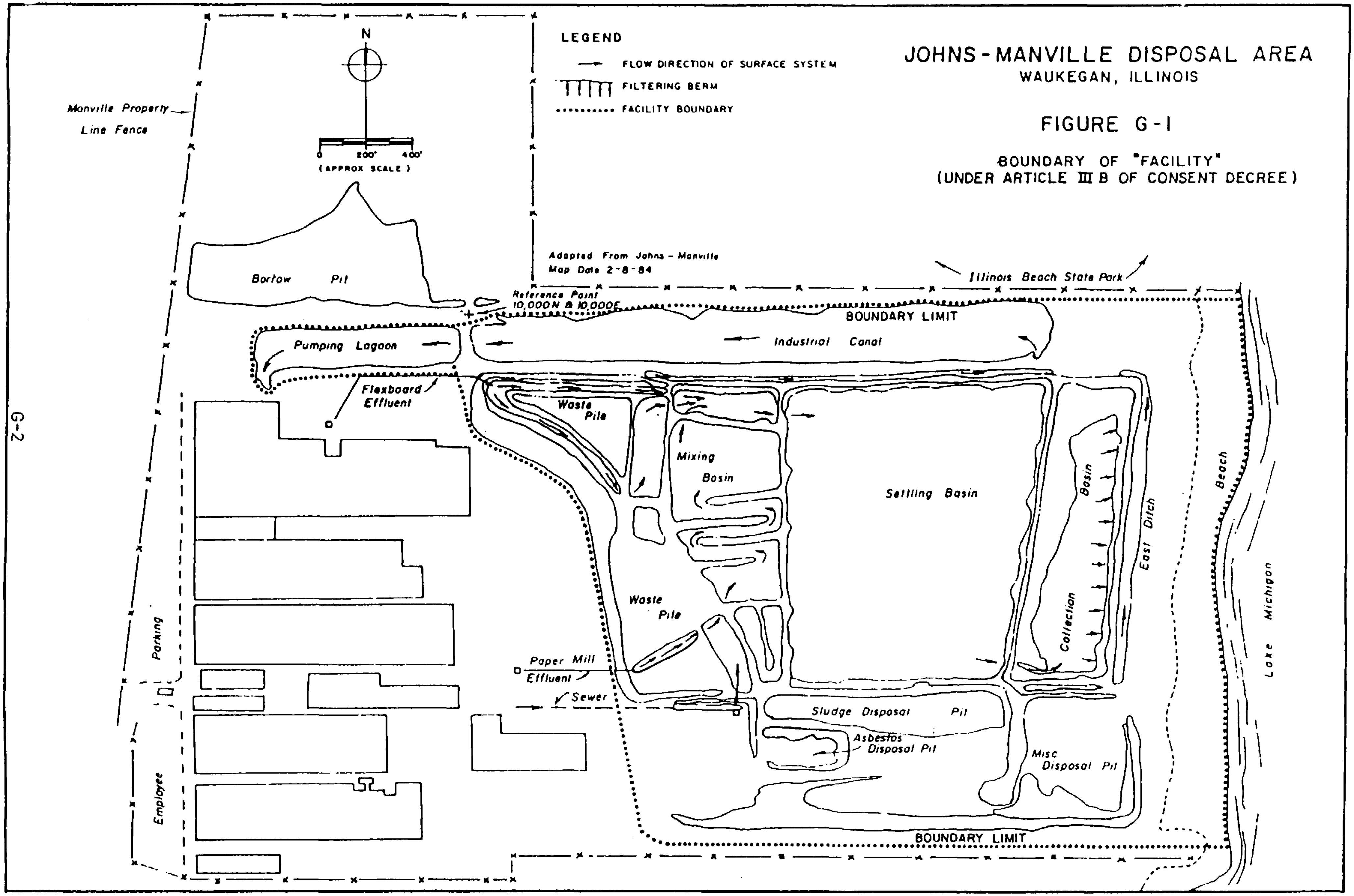
No asbestos has been used in the manufacturing processes in the recent past. Small quantities of asbestos-containing wastes generated from plant equipment and building asbestos decontamination activities were disposed of in the Asbestos Disposal Pit.

In 1982 this site was included in the National Priorities List. Since then, under the June 1984 Consent Order, Manville completed Remedial Investigation and Feasibility Study. U.S. EPA subsequently issued a Record of Decision (ROD) and Manville signed a Consent Decree for Remedial Action on Dec. 31, 1987. Under this Consent Decree, a Remedial Action involving a soil cover over the inactive waste disposal areas with vegetation and other improvements is being implemented. This Health and Safety Plan is to be followed for various site activities to be carried out during the implementation of the Remedial Action.

2.0 GENERAL DIRECTIVES

2.1 Purpose

The purpose of this Health and Safety Plan (HSP) is to establish personnel safety/protection standards, define responsibilities of



LEGEND
FLOW DIRECTION OF SURFACE SYSTEM
FILTERING BERM
FACILITY BOUNDARY
JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS
FIGURE G-1
BOUNDARY OF "FACILITY"
(UNDER ARTICLE III B OF CONSENT DECREE)
N
0 200' 400'
(APPROX SCALE)
Manville Property Line Fence
Adapted From Johns-Manville Map Date 2-8-84
Borrow Pit
Reference Point 10,000N & 10,000E
Illinois Beach State Park
BOUNDARY LIMIT
Pumping Lagoon
Industrial Canal
Flexboard Effluent
Waste Pile
Mixing Basin
Settling Basin
Collection Basin
East Ditch
Beach
Lake Michigan
Waste Pile
Paper Mill Effluent
Sewer
Sludge Disposal Pit
Asbestos Disposal Pit
Misc Disposal Pit
Parking
Employee
BOUNDARY LIMIT

different organizations and personnel involved, establish safety operating procedures relative to physical and chemical conditions encountered on the site, delineate Contamination Areas (Designated Work Areas), establish decontamination procedures, and provide for contingencies which may arise during the course of the Remedial Action.

2.2 Applicability

This HSP addresses the safety procedures that will be followed by personnel visiting the site or involved in the Remedial Activities during the Remedial Work.

This Protocol will be read and signed by all personnel entering the site. This protocol will remain in effect until the Manville Remedial Construction Manager (RCM) certifies that the activity is terminated or otherwise modifies the HSP. This HSP does not supercede any Federal, State or local regulations. In the event of a conflict between this plan and a regulation, the more stringent of the two would be followed.

2.3 Health and Safety Responsibilities

The field operations organization for Health and Safety related activities is shown in Figure G-2. The General Contractor has primary responsibilities for implementing and monitoring all health and safety related activities on the site.

2.3.1 Site Health & Safety Manager

The responsibilities of the Manville Remedial Construction Manager/Site Health and Safety Manager will be:

- To ensure that all personnel allowed to enter the site (i.e., EPA, contractors, State, visitors) are aware of the potential hazards associated with substances known or suspected and the ongoing activities at the site;
- To ensure that the personnel working in a hazardous environment have appropriate health and safety training and are enrolled in an adequate medical monitoring program;
- To ensure that all personnel allowed to enter the site are aware of the provisions of this plan and are instructed in the safety practices defined in the plan, including its emergency procedures;
- To ensure that the appropriate safety equipment is available and properly utilized by all personnel on the site.

Field Operations Organization

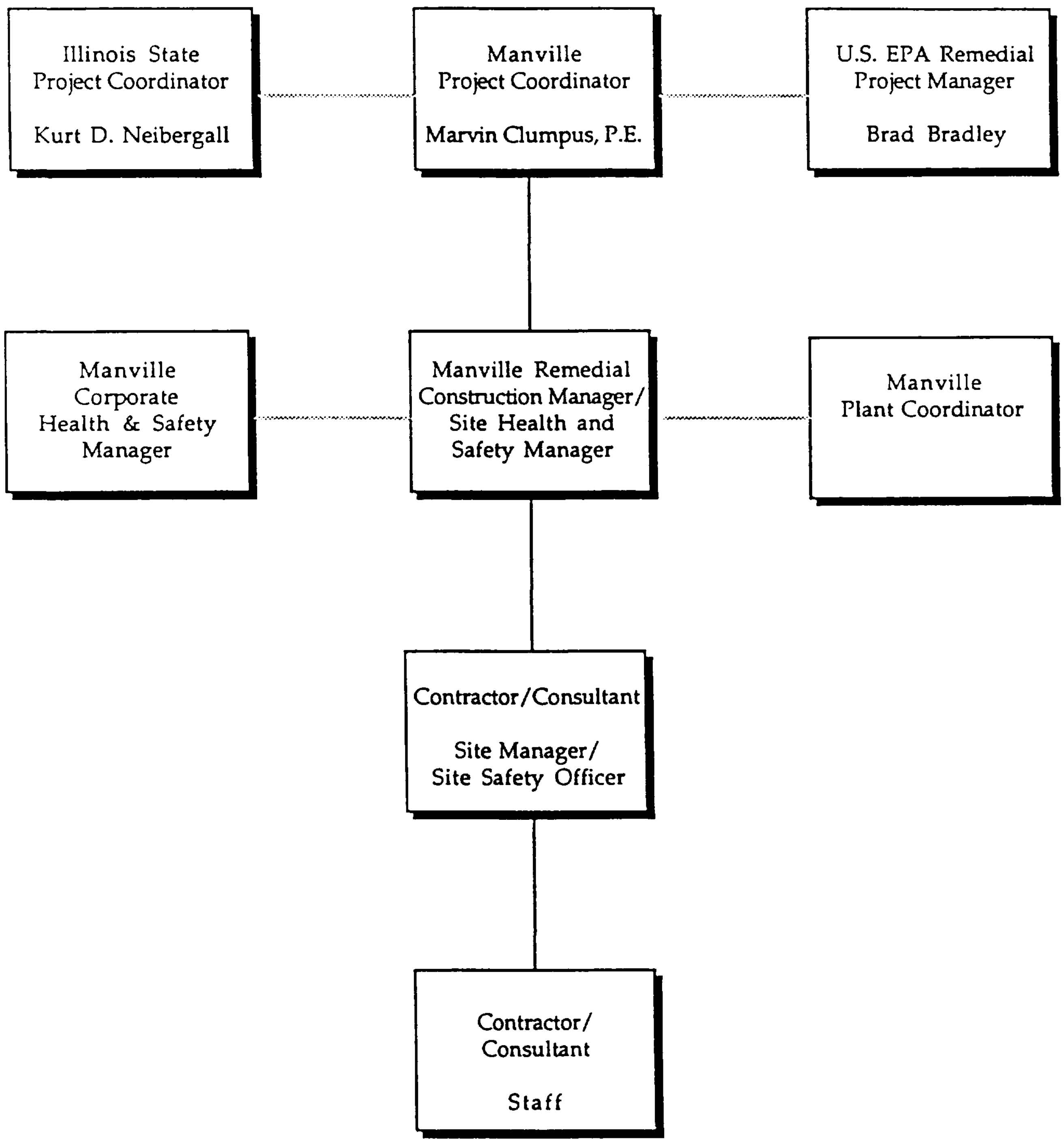


Figure G-2

The Health and Safety Manager may alter this Safety Plan to fit on-site conditions. U.S. EPA and IEPA will be made aware of the modifications to the Health and Safety Plan.

2.3.2 Site Safety Officer

Each contractor will designate a Site Safety Officer who will be responsible for implementing the Health and Safety Plan at the site. The Site Safety Officer will:

- Monitor compliance of workers relative to safety training, medical monitoring program and pre-established personal protection levels (i.e., use of necessary clothing and equipment to ensure the safety of personnel);
- Notify Manville Health and Safety Manager of discrepancies or violations of the Health and Safety Plan;
- Recommend to the H&S Manager any necessary modifications to Health and Safety Plan and personal protection levels to maintain personnel safety (based on weather and other conditions);
- Direct the action of all personnel and ensure compliance with health and safety procedures;
- Record and report accidents and injuries to site H&S Manager.

3.0 SITE HAZARDS

3.1 CHEMICAL CONTAMINANTS

The concentrations of the contaminants detected in the soil during Remedial Investigation are presented in Appendix G-A (reproduced from RI report).

Asbestos, lead and chromium have been identified as the contaminants of primary concern and are discussed in this section.

3.1.1 Asbestos

Asbestos is a general name given to a variety of fibrous minerals. The major asbestos mineral on site is chrysotile.

Inhalation of asbestos may cause asbestosis, pleural or peritoneal mesothelioma, and/or lung cancer.

Asbestos related disease usually develops after long exposure to high concentrations of airborne respirable asbestos fiber. Risk varies directly with the length of exposure and concentration. Smoking has been found to increase health risk significantly. Threshold Limit Value - Time Weighted Average (TLV-TWA) for asbestos is 0.2 fibers per c.c.

3.1.2 Lead

Some elevated levels of lead were detected at the site. Inhalation and ingestion of lead has been associated with blood disorder, neurological dysfunctions and may be associated with cancer. Threshold Limit Value (TLV) for inorganic lead (dust or fumes) is 150 ug/m^3 as set by American Conference of Governmental Industrial Hygienists.

3.1.3 Chromium

Slightly elevated levels of chromium were detected at the site.

Inhalation and dermal contact with hexavalent chromium compounds has been associated with respiratory problems, kidney and liver disorders, contact dermatitis and skin ulceration. Chromium in ambient air is not regulated so far.

Full face respirators with GMC-H cartridges may be used to protect against these airborne, chemical contaminants.

3.2 Physical Hazards

The site consists of embankments, steep slopes and process wastewater treatment basins and involves vehicular traffic due to on going waste disposal activities. These can be sources of physical hazards. Contractor would make his employees aware of the nature of the physical hazards of this site and establish proper safety procedures including on-site traffic patterns to route vehicles in an orderly manner to avoid accidents.

3.3 Heat and Cold Stress

The heat stress load on the site workers will be assessed continuously by contractor's supervisors and the SSO. Heat stress monitoring may not be done if temperatures do not present any immediate health hazard.

The wearing of protective clothing in warm environments creates a heat stress potential. Some of the following control measures may be used to help control heat stress.

- Provision of adequate liquids to replace lost body fluids;

- Electrolyte replacement fluids should be available for use;

- A work regime established such that it provides adequate rest periods for cooling down;

- Rest area to be a cool area;

Temperatures at or below freezing may cause frostbite to the persons working outdoors. Extreme cold for a short time may cause severe injury to the body surface or result in profound general cooling, causing death. The SSO will monitor the workers for the cold stress symptoms and warm rest areas will be provided. Warm clothing should be worn by personnel during cold temperatures.

4.0 SAFETY PROCEDURES AND LEVELS OF PROTECTION

4.1 Respiratory Protection Program

All personnel involved in on-site activities will be given a respiratory protection program. All personnel wearing air-purifying respirators on-site are required to be fit tested, be physically qualified to wear a respirator, and must be properly trained in their use. All respiratory protection equipment is to be properly decontaminated at the end of each workday. A respirator cartridge will be used only when it comes from a properly sealed container and its shelf life has not expired. Cartridges will be changed once a day or more frequently if the wearer begins to smell any material or notices increased resistance to breathing. No bent, distorted or wet cartridge will be used.

Persons having beards will not enter areas requiring respiratory protection.

4.2 Training

Personnel will have appropriate health and safety instructions/training (formal training or on-the-job training) for those tasks they are assigned to perform on the site.

4.3 General Safety Rules and Equipment

- There will be absolutely no smoking on site.

- Work areas will be designated regularly. Level C/D Protection, as appropriate, will be used in the Designated Work Area (Contamination Area). All other areas will be considered as Support Areas.

- There will be no eating or drinking on site except in designated areas.

- <u>All</u> personnel must pass through the Decontamination Area/Facility, before entering or exiting Contamination Area (Designated Work Area).

- As a minimum, an emergency deluge shower/spray facility is to be located on the clean side of the Decontamination Area/Facility.

- Fire extinguishers will be available on-site.

- Each contractor will have his own emergency procedures and First Aid measures.

- OSHA approved First-Aid kit will be located on the site.

- Parking of non-essential vehicles inside of the Designated Work Area will not be permitted.

- No work will be performed in the Contamination Area (Designated Work Area) during hours of darkness as determined by the Site Health and Safety Manager.

4.4 <u>Morning Tool Box Meetings</u>

This H & S plan will be discussed as part of the Contractor's daily Tool Box meetings.

4.5 <u>Site Control</u>

Site access must be controlled to minimize risk of exposure to regulated substances on site. The site access will be controlled by proper fencing and appropriate warning signs. Except in an emergency, all personnel will enter and exit through the Decontamination Area/Facility.

4.6 <u>Personnel Protection</u>

Personnel protective equipment and safety requirements must be appropriate to protect against the known hazards on the site. The appropriate level of protection will be determined using U.S. EPA recommended standard, safety operating guidelines (see Appendix G-B). Changes in work conditions may result in changing of the original protection level selected. Protection levels C and D will be used for Remedial Work at this site.

4.7 <u>Levels of Personnel Protection</u>

4.7.1 <u>Level C</u>

Level C protection is selected when the types and concentrations of respirable materials are known, have adequate warning properties, or are reasonably assumed to be not greater than the protection factors associated with air-purifying respirators. A modified level C personnel protection outlined below will be used for work performed in the Designated Contamination Area. In addition, continuous monitoring of site and/or individuals will be established as discussed in Section 6.0 of this H & S plan.

4.7.1.1 Personnel Protection Equipment recommended for Level C protection at this site is a slight modification of the standard Level C Protection Equipment discussed in Appendix G-B and will include:

- o Full-face, air-purifying respirator (NIOSH approved) with combination (GMC-H) cartridges.
- o Tyvek coverall with hood;
- o Gloves - Outer;
- o Gloves - Inner;
- o Hard Hat (face shield, optional);
- o Boots (Chemical-protective with steel toe and shank)
- o Two-way radio communications, when required;
- o Equipment operators may use half-face respirators and dust proof goggles in place of full-face respirators.

4.7.2 Level D

Level D is the basic work uniform and should be worn for all site operations except when Level C protection is required.

4.7.2.1 Personnel Protection Equipment Recommended for Level D protection at this site:

- o Coveralls (cotton or tyvek)
- o Boots/Shoes (Leather or chemical-resistant with steel-toe and shank);
- o Dust Masks (mouth pieces only), when necessary;
- o Half-face respirators immediately available, when necessary;
- o Safety glasses or safety goggles, when necessary;

- Gloves (optional);
- Hard hat (face shield optional).

4.8 Designation of Work Areas at the Site

At all times the entire site will be divided into three areas by the Manville Remedial Construction Manager(Site Health and Safety Manager). These areas will be designated as follows:

- Contamination Area (CA), where contaminant exposure hazards exist and requires Level C protection.
- Decontamination Area, where decontamination of personnel and equipment exiting the Contamination Area is performed;
- The Support Area, which is the remaining site area not requiring Level C protection.

5.0 DECONTAMINATION PROTOCOL

Decontamination Protocol will involve the thorough decontamination of all equipment and personnel leaving the Contamination Area. Changes to the decontamination techniques will be dictated by the Site Health and Safety Manager to accommodate changing site operations.

The basic outline for Decontamination Protocol will involve:

5.1 Personnel Decontamination

Upon exiting the Contamination Area, all personnel are required to be decontaminated by means of the following procedure:

- Remove any gross contaminants;
- Scrub down outer boots in decon solution containing soap and water and wash off boots in rinse (tap water) solution;
- Remove boots and place upside down on boot-rack
- If wearing reusable rain gear, it should be scrubbed down with decon solution, rinsed, and then hung on pegs;
- Disposable tyveks should be removed and placed in trash barrels located outside of the decon trailer;
- Remove disposable gloves and place in trash barrel;
- Use a new set of disposable gloves to clean any equipment;

- Remove respirator and place spent cartridges in the trash barrel;

- Hard hats, respirators, and deconned equipment can be stored inside the decon trailer. Respirators should be rinsed in sanitizing solution at the end of each day.

- Showers should be available in the decontamination trailer. Shower and dress for exit to Support Area.

5.2 Equipment Decontamination

5.2.1 Decontamination of large equipment (vehicles, drill rigs, augers and associated equipment) entering and exiting the Restricted Areas (Designated Work Areas) will be performed at a vehicle/large equipment decontamination station. This decontamination station would be constructed according to the details contained in Attachment B.

Cleaning of tires and undercarriage will consist of Industrial Canal water or City water sprays using a high pressure hose. Additional scrubbing may be required to remove encrusted materials. Decontaminated equipment may be stored on plastic sheeting and/or platforms above the ground surface. Contaminated water can be disposed in Asbestos Disposal Pit.

5.2.2 Decontamination of large vehicles, equipment which are permanently on site will be accomplished once after completion of grading and smoothing and at the end of the construction phase. The equipment will be decontaminated using water sprays. The contaminated wash water can be disposed of in Asbestos Disposal Pit.

6.0 DUST CONTROL

No visible emission will be allowed in the Restricted/Contamination/Designated Work Area. Wetting of the work areas is the preferred method for the prevention of visible dust/emissions. It will be the responsibility of the contractor's Site Health and Safety Officer to observe that this requirement of no visible emission is maintained. In the event any visible emissions are noted, work will stop immediately, and the area will be wetted sufficiently before work is started again. Work should not be done at any time when visible emissions cannot be observed, such as dusk/dawn /nighttime.

An Ambient Air Monitoring program presented in QAPP-3 (Attachment C3) will be implemented during initial phases of the Remedial Work from site grading to placing of first layer of soil cover. The objective of this monitoring is to assure that the quality of air in the vicinity of the construction area is not impaired due to handling of the asbestos-contaminated materials.

Ambient air monitoring will consist of meteorological measurements (local wind speed and direction) by using a recording anemometer, perimeter downwind air asbestos fiber monitoring using 24-hour sampling and perimeter downwind asbestos fiber monitoring using 4 to 8 hour sampling. The details of sampling locations, number of samples and methods of analysis are presented in QAPP-3.

A continuous personnel air-monitoring program (presented in Appendix G-C) will be implemented during the on-site working hours during construction activities from site grading to placing of first layer of soil cover.

Personal air monitoring will be conducted daily with the personal sampling surveys by 0.8 micrometer porosity cellulose ester filter with air flow rates of 0.5 liters/min. to 2.5 liters/min. Four personal air monitoring samples will be taken daily and only two will be analyzed daily (as outlined in Appendix G-C). The objective of this monitoring is to assure that asbestos fiber concentrations in the breathing zone of on-site personnel do not exceed permissible time-weighted average exposure concentrations. Exposure of any worker would not exceed 8-hr. weighted average airborne asbestos concentration of 0.2 fibers/cc. An action level of 0.1 fibers/cc may be used for Support Areas. Personal air monitoring data will be summarized and made available to U.S. EPA and IEPA by telephone or otherwise when received from the contractor. In general, all air monitoring data will be due (by telephone or in the written form) from the contractor within 24 hours of monitoring.

The samples will be analyzed by the Phase Contrast Microscopy (PCM) NIOSH method 7400.

It will be the duty of the contractor's Site Health and Safety Officer to ensure that the various elements of this Airborne Particle Control System are properly maintained and any discrepancies must be reported to Manville H&S Manager/Remedial Construction Manager.

7.0 EMERGENCY RESOURCES

The following emergency information will be posted prominently at each trailer and telephone on-site for appropriate use of the Contractor personnel. This will be in addition to the contractor's emergency procedures and first aid measures for on-site personnel.

AREA CODE (312)

AREA RESOURCES

Ambulance:	623-2121	Waukegan Fire Dept.
Hospital Emergency Room:	578-4181	Victoria Memorial Hospital
Poison Control Center:	1-800-942-5969	Rush Presbyterian, St. Luke's Hospital, Chicago General.
Police Emergency:	623-2131 684-7550	Waukegan Police Dept.
Fire Department:	623-2121	Waukegan Fire Dept.
Airport:	244-0055,	Waukegan Memorial Airport
Explosives Unit:	623-2121	Waukegan Fire Dept.
EPA Contact:	1-886-4742	Brad Bradley

SITE RESOURCES

Water Supply:	Manville Sales Corp.	City of Waukegan
Telephone:	Contractor's Trailer	

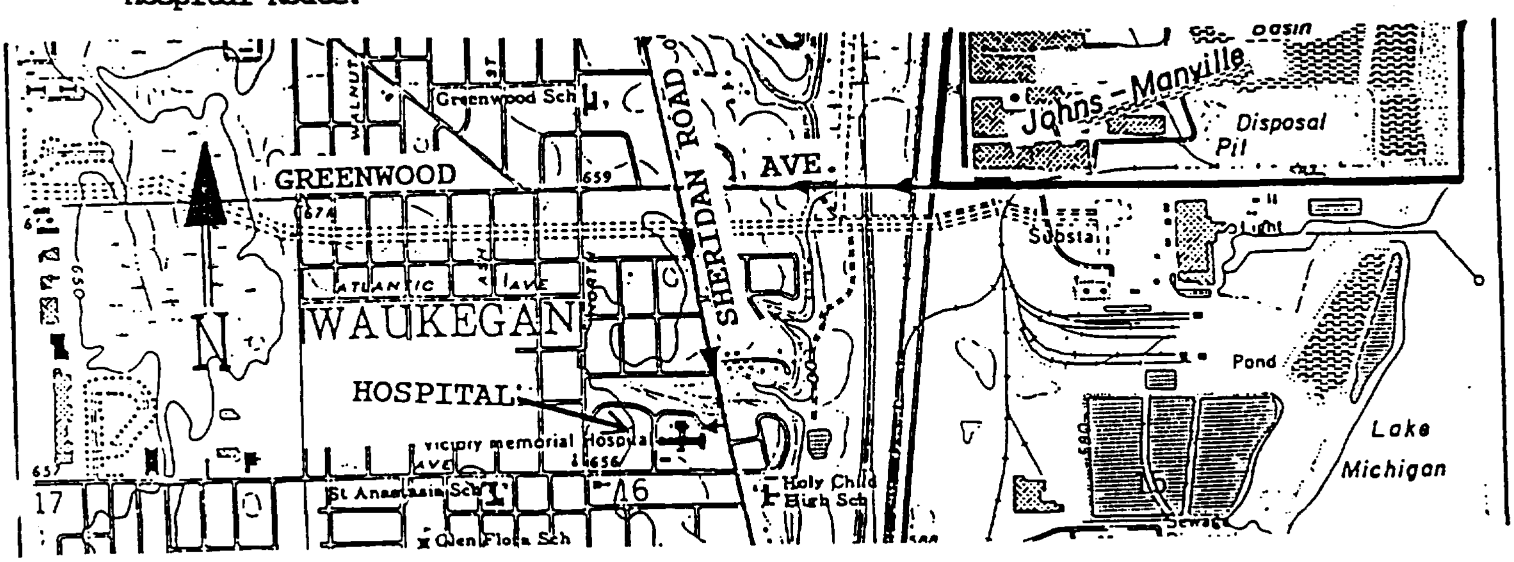
EMERGENCY CONTACTS

Site Safety Officer: ________________________________

Site H&S Manager: ________________________________

Hospital: Victory Memorial Hospital
1324 N. Sheridan Road
Waukegan, Illinois 60085

Hospital Route:



SIGNATURE PAGE

I have read and reviewed the site-specific Health and Safety Plan for the Johns-Manville Disposal Area and understand the information presented. I will comply with the provisions contained therein.

NAME	ORGANIZATION	DATE
CHETAN TRIVEDI	CCJM	10/25/88
John B. Tweddale	CCJM	10/25/88
KURT D. NEIBERGALL	IEPA	10-25-88
George C Davis	Manville	10-25-88
David T. Heidlauf	CCJM	10-25-88
MARK A. GARWICK	ETI	10-25-88
KEN R TAINTER	ETI	10-25-88
Thomas R Morrison	CCJM	10-25-88
Kurt Ettinger	Kemron	10-25-88
Todd Coster	ETI	10-26-88
JOSEPH J. MARK	CCJM	11-16-88
George E. McIntosh	CCJM	1-20-88
Dudley Pieri	EDI	1-20-88
Eric Mefford	EDI	4-25-89
Randall L Mattzela	CCJM	4-26-89
Samuel [illegible]	CRA	6-1-89
Annie V. Papa R.S.	Lake County Health Dept.	9-13-90
[illegible]	Fox Drilling	9-13-90
Paul Egan	Fox Drilling	9-13-90

SIGNATURE PAGE

I have read and reviewed the site-specific Health and Safety Plan for the Johns-Manville Disposal Area and understand the information presented. I will comply with the provisions contained therein.

NAME	ORGANIZATION	DATE
[illegible]	Conestoga-Rovers & Associates	9/13/90
William [illegible]	CCJM	9/13/90
[illegible]	CCJM	9/13/90
Brent [illegible]	Conestoga-Rovers & Associates	9/13/90
Stacey [illegible]	CONESTOGA-ROVERS & ASSOC.	9/13/90

LAKE COUNTY GRADING COMPANY

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APPENDIX G-A

SOIL CONTAMINANT DATA

(Reproduced from 1985 RI Report)

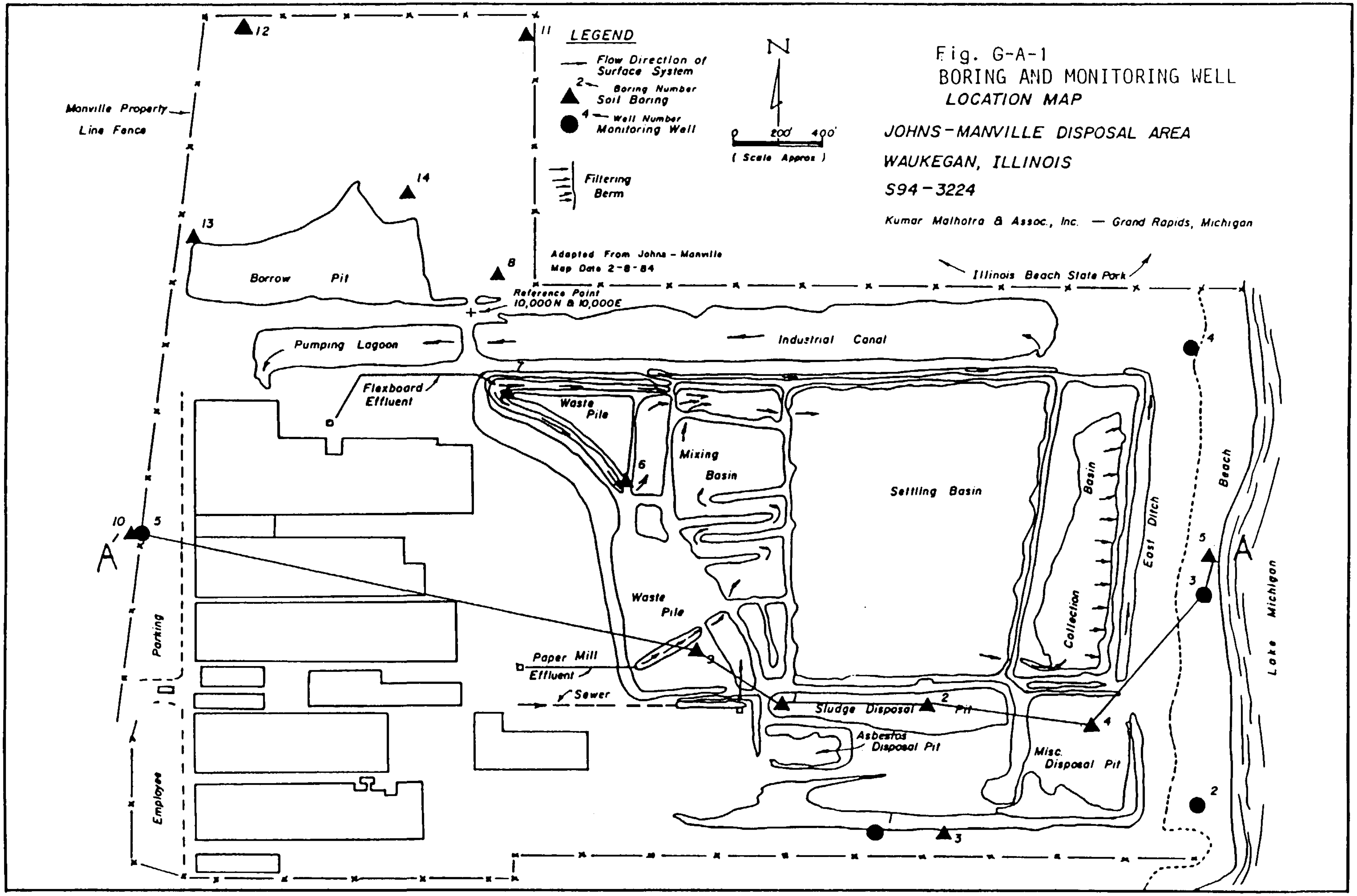

Fig. G-A-1
BORING AND MONITORING WELL
LOCATION MAP
JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS
S94-3224
Kumar Malhotra & Assoc., Inc. — Grand Rapids, Michigan
LEGEND
Flow Direction of Surface System
Boring Number
Soil Boring
Well Number
Monitoring Well
Filtering Berm
N
0 200' 400'
(Scale Approx)
Adapted From Johns - Manville
Map Date 2-8-84
Manville Property Line Fence
Illinois Beach State Park
Borrow Pit
Reference Point
10,000N & 10,000E
Pumping Lagoon
Industrial Canal
Flexboard Effluent
Waste Pile
Mixing Basin
Settling Basin
Collection Basin
East Ditch
Beach
Lake Michigan
Waste Pile
Paper Mill Effluent
Sewer
Sludge Disposal Pit
Asbestos Disposal Pit
Misc. Disposal Pit
Parking
Employee
A
A

Table. G-A-1 SUMMARY OF RESULTS OF CHEMICAL ANALYSIS

BORING NUMBER	B-1			B-2			B-3			B-4				B-5
Boring Depth in Feet	Near Surface	14-15.5	31.5 33.0	Surface	21.5-23.0	34-35.5	Surface	Near Surface	39.5-40	Field Blank	Near Surface	6.5-8.0	14-15.5	At 20
Chemical Parameter (mg/kg)														
Chromium, Total	16	29	9	81	42	6.6	23	12	6.1	3.8	4.4	25	5.8	1.3
Lead, Total	86	3700	630	1100	2600	190	4700	1300	13	2.4	22	1400	140	8.2
Asbestos %	< 1	<1	<1	<1	<1	<1	<1	<1	<1	0	<1	<1	<1	<1
Toluene (U220)	< .02	.31	0.14	-	0.51	-	-	-	-	-	0.31	-	0.62	-
Ethyl Benzene	< .02	-	-	-	.08	-	-	-	-	-	-	-	1.4	-
Di-N-Butylphthalate	< .028	0.31	0.74	-	1.2	0 28	-	-	-	0.53	0.31	0.14	0.26	-
1,2-Dichlorobenzene (U070)	0.12	0.27	-	0.58	0.78	-	<.028	-	-	-	-	-	0.20	-
1,3-Dichlorobenzene (U071)	< .028	-	-	0.077	0.061	-	-	-	-	-	-	-	-	-
Bis(2-Ethylhexyl) Phthalate (U028)	3.6	2.5	3.3	4.6	14	5.1	-	-	-	24	8.9	3.5	4.2	-
Di-N-Octyl Phthalate (U107)	< .028	0.55	0.49	-	1.5	3.3	-	-	0.064	9	1.7	1.0	0.52	-
Fluorene	< .028	0.051	-	-	0.18	-	-	-	-	-	.077	-	0.43	-
Fluoranthene	0.12	0.053	0.035	0.085	0.33	0.20	0.088	<.028	-	-	.093	-	0.34	-
Pyrene	0.13	0.089	0.043	0.098	0.30	0.19	0.092	0.16	-	-	-	.046	0.33	-
Phenanthrene	0.046	0.16	<.055	0.19	0.56	0.06	0.16	0.10	-	-	0.15	0.062	0.57	-
Anthracene	< 0.028	0.037	-	-	0.15	<0.028	0.040	0.084	-	-	-	-	.092	0.032
Benzo (A) Anthracene	< 0.028	-	-	-	-	0.20	0.045	0.074	-	-	-	-	-	-
Naphthalene (U165)	0.054	0.78	0.089	0.050	1.8	<.028	0.095	0.057	-	-	0.95	0.097	2.1	-
p-Chloro-m-Cresol (U039)	0.42	1.0	<0.02	-	0.47	-	-	-	-	-	-	-	-	-
Pentachlorophenol (U242)	< 0.3	-	-	-	-	-	6.5	-	-	-	-	-	-	12
2,4,6 Trichloro Phenol (U231)	< 0.03	-	-	-	0.45	-	-	-	-	-	-	-	-	-
PCB 1254	0.2	0.2	<0.1	0.3	0.2	-	0.2	-	-	-	-	-	-	-
Thiram	< 0.028	-	-	-	-	-	-	-	-	-	-	-	-	-

- Non Detectable

APPENDIX G-B

U.S. EPA RECOMMENDED
STANDARD OPERATING SAFETY GUIDES

STANDARD OPERATING SAFETY GUIDES

November 1984

ENVIRONMENTAL RESPONSE BRANCH

HAZARDOUS RESPONSE SUPPORT DIVISION

OFFICE OF EMERGENCY AND REMEDIAL RESPONSE

U.S. ENVIRONMENTAL PROTECTION AGENCY

SITE ENTRY - LEVELS OF PROTECTION

I. INTRODUCTION

Personnel must wear protective equipment when response activities involve known or suspected atmospheric contamination, when vapors, gases, or particulates may be generated by site activities, or when direct contact with skin-affecting substances may occur. Full face-piece respirators protect lungs, gastrointestinal tract, and eyes against airborne toxicants. Chemical-resistant clothing protects the skin from contact with skin-destructive and absorbable chemicals. Good personal hygiene limits or prevents ingestion of material.

Equipment to protect the body against contact with known or anticipated toxic chemicals has been divided into four categories according to the degree of protection afforded:

- Level A: Should be worn when the highest level of respiratory, skin, and eye protection is needed.

- Level B: Should be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection.

- Level C: Should be worn when the criteria for using air-purifying respirators are met.

- Level D: Should be worn only as a work uniform and not on any site with respiratory or skin hazards. It provides no protection against chemical hazards.

The Level of Protection selected should be based on:

- Type and measured concentration of the chemical substance in the ambient atmosphere and its toxicity.

- Potential for exposure to substances in air, splashes of liquids, or other direct contact with material due to work being done.

In situations where the type of chemical, concentration, and possibilities of contact are not known, the appropriate Level of Protection must be selected based on professional experience and judgment until the hazards can be better identified.

While personnel protective equipment reduces the potential for contact with toxic substances, ensuring the health and safety of responders requires, in addition, safe work practices, decontamination, site entry protocols, and other safety procedures. Together, these provide an integrated approach for reducing harm to workers.

II. LEVELS OF PROTECTION

A. Level A Protection

1. Personnel protective equipment

- Supplied-air respirator approved by the Mine Safety and Health Administration (MSHA) and National Institute for Occupational Safety and Health (NIOSH). Respirators may be:

  -- pressure-demand, self-contained breathing apparatus (SCBA)

  or

  -- pressure-demand, airline respirator (with escape bottle for Immediately Dangerous to Life and Health (IDLH) or potential for IDLH atmosphere)

- Fully encapsulating chemical-resistant suit

- Coveralls*

- Long cotton underwear*

- Gloves (inner), chemical-resistant

- Boots, chemical-resistant, steel toe and shank. (Depending on suit construction, worn over or under suit boot)

- Hard hat* (under suit)

- Disposable gloves and boot covers* (Worn over fully encapsulating suit)

- Cooling unit*

- 2-Way radio communications* (inherently safe)

2. Criteria for selection

Meeting any of these criteria warrants use of Level A Protection:

- The chemical substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on:

  -- measured (or potential for) high concentration of

*Optional

atmospheric vapors, gases, or particulates

or

-- site operations and work functions involves high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials highly toxic to the skin.

- Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible.

- Operations must be conducted in confined, poorly ventilated areas until the absence of substances requiring Level A protection is determined.

- Direct readings on field Flame Ionization Dectors (FID) or Photoionization Detectors (PID) and similar instruments indicate high levels of unidentified vapors and gases in the air. (See Appendixes I and II.)

3. Guidance on selection

a. Fully encapsulating suits are primarily designed to provide a gas or vapor tight barrier between the wearer and atmospheric contaminants. Therefore Level A is generally worn when high concentrations of airborne substances are known or thought to be present and these substances could severely effect the skin. Since Level A requires the use of a self-contained breathing apparatus, the eyes and respiratory system are also more protected.

Until air surveillance data are available to assist in the selection of the appropriate Level of Protection, the use of Level A may have to be based on indirect evidence of the potential for atmospheric contamination or other means of skin contact with severe skin affecting substances.

Conditions that may require Level A protection include:

- Confined spaces: Enclosed, confined, or poorly ventilated areas are conducive to build up of toxic vapors, gases, or particulates. (Explosive or oxygen-deficient atmospheres also are more probable in confined spaces.) Confined space entry does not automatically warrant wearing Level A protection, but should serve as a cue to carefully consider and to justify a lower Level of Protection.

- Suspected/known highly toxic substances: Various substances that are highly toxic especially through skin absorption for example, fuming corrosives, cyanide compounds, concentrated pesticides, Department of Transportation Poison "A" materials, suspected carcinogens, and infectious substances may be known or suspected to be involved. Field instruments may not be available to detect or quantify air concentrations of these materials. Until these substances are identified and concentrations measured, maximum protection may be necessary.

- Visible emissions: Visible air emissions from leaking containers or railroad/vehicular tank cars, as well as smoke from chemical fires and others, indicate high potential for concentrations of substances that could be extreme respiratory or skin hazards.

- Job functions: Initial site entries are generally walk-throughs in which instruments and visual observations are used to make a preliminary evaluation of the hazards. In initial site entries, Level A should be worn when:

  -- there is a probability for exposure to high concentrations of vapors, gases, or particulates.

  -- substances are known or suspected of being extremely toxic directly to the skin or by being absorbed.

Subsequent entries are to conduct the many activities needed to reduce the environmental impact of the incident. Levels of Protection for later operations are based not only on data obtained from the initial and subsequent environmental monitoring, but also on the probability of contamination and ease of decontamination.

Examples of situations where Level A has been worn are:

- Excavating of soil to sample buried drums suspected of containing high concentrations of dioxin.

- Entering a cloud of chlorine to repair a value broken in a railroad accident.

- Handling and moving drums known to contain oleum.

- Responding to accidents involving cyanide, arsenic, and undiluted pesticides.

b. The fully encapsulating suit provides the highest degree of protection to skin, eyes, and respiratory system if the suit material resists chemicals during the time the suit is worn. While Level A provides maximum protection, all suit material may be rapidly permeated and degraded by certain chemicals from extremely high air concentrations, splashes, or immersion of boots or gloves in concentrated liquids or sludges. These limitations should be recognized when specifying the type of fully encapsulating suit. Whenever possible, the suit material should be matched with the substance it is used to protect against.

B. Level B Protection

1. Personnel protective equipment

- Supplied-air respirator (MSHA/NIOSH approved). Respirators may be:

  -- pressure-demand, self-contained breathing apparatus

  or

  -- pressure-demand, airline respirator (with escape bottle for IDLH or potential for IDLH atmosphere)

- Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one or two-piece chemical-splash suit; disposable chemical-resistant, one-piece suits)

- Long cotton underwear*

- Coveralls*

- Gloves (outer), chemical-resistant

- Gloves (inner), chemical-resistant

- Boots (outer), chemical-resistant, steel toe and shank

- Boot covers (outer), chemical-resistant (disposable)*

- Hard hat (face shield)*

- 2-Way radio communications* (intrinsically safe)

2. Criteria for selection

Meeting any one of these criteria warrants use of Level B protection:

- The type and atmospheric concentration of toxic substances has been identified and requires a high level of respiratory protection, but less skin protection than Level A. These would be atmospheres:

*Optional

-- with concentrations Immediately Dangerous to Life and Health, but substance or concentration in the air does not represent a severe skin hazard

or

-- that do not meet the selection criteria permitting the use of air-purifying respirators.

- The atmosphere contains less than 19.5% oxygen.

- It is highly unlikely that the work being done will generate high concentrations of vapors, gases or particulates, or splashes of material that will affect the skin of personnel wearing Level B protection.

- Atmospheric concentrations of unidentified vapors or gases are indicated by direct readings on instruments such as the FID or PID or similar instruments, but vapors and gases are not suspected of containing high levels of chemicals toxic to skin. (See Appendixes I and II.)

3. Guidance on selection

   a. Level B does not afford the maximum skin (and eye) protection as does a fully encapsulating suit since the chemical-resistant clothing is not considered gas, vapor, or particulate tight. However, a good quality, hooded, chemical-resistant, one-piece garment, with taped wrist, ankles, and hood does provides a reasonable degree of protection against splashes and to lower concentrations in air. At most abandoned hazardous waste sites, ambient atmospheric gas or vapor levels have not approached concentrations sufficiently high to warrant Level A protection. In all but a few circumstances (where highly toxic materials are suspected) Level B should provide the protection needed for initial entry. Subsequent operations at a site require a reevaluation of Level B protection based on the probability of being splashed by chemicals, their effect on the skin, the presence of hard-to-detect air contaiminants, or the generation of highly toxic gases, vapors, or particulates, due to the work being done.

   b. The chemical-resistant clothing required in Level B is available in a wide variety of styles, materials, construction detail, and permeability. One or two-piece garments are available with or without hoods. Disposal suits with a variety of fabrics and design characteristics are also available. Taping joints between the gloves, boots and suit, and between hood and respirator reduces the possiblity for splash and vapor or gas penetration. These factors and other selection criteria all affect the degree of protection afforded. Therefore, a specialist should select the most effective chemical-resistant clothing based on the known or anticipated hazards and job function.

Level B equipment does provides a high level of protection to the respiratory tract. Generally, if a self-contained breathing apparatus is required for respiratory protection, selecting chemical-resistant clothing (Level B) rather than a fully encapsulating suit (Level A) is based on needing less protection against known or anticipated substances affecting the skin. Level B skin protection is selected by:

- Comparing the concentrations of known or identified substances in air with skin toxicity data.

- Determining the presence of substances that are destructive to or readily absorbed through the skin by liquid splashes, unexpected high levels of gases, vapor, or particulates, or other means of direct contact.

- Assessing the effect of the substance (at its measured air concentrations or potential for splashing) on the small areas left unprotected by chemical-resistant clothing. A hooded garment taped to the mask, and boots and gloves taped to the suit further reduces area of exposure.

c. For initial site entry and reconnaissance at an open site, approaching whenever possible from upwind, Level B protection (with good quality, hooded, chemical-resistant clothing) should protect response personnel, providing the conditions described in selecting Level A are known or judged to be absent.

C. <u>Level C Protection</u>

1. Personnel protective equipment

   - Air-purifying respirator, full-face, canister-equipped (MSHA/NIOSH approved)

   - Chemical-resistant clothing (coveralls; hooded, one-piece or two-piece chemical splash suit; chemical-resistant hood and apron; disposable chemical-resistant coveralls)

   - Coveralls*

   - Long cotton underwear*

   - Gloves (outer), chemical-resistant

- Gloves (inner), chemical-resistant*

- Boots (outer), chemical-resistant, steel toe and shank

- Boot covers (outer), chemical-resistant (disposable)*

- Hard hat (face shield*)

- Escape mask*

- 2-Way radio communications* (inherently safe)

2. Criteria for selection

   Meeting all of these criteria permits use of Level C protection:

   - Oxygen concentrations are not less than 19.5% by volume.

   - Measured air concentrations of identified substances will be reduced by the respirator below the substance's threshold limit value (TLV) and the concentration is within the service limit of the canister.

   - Atmospheric contaminant concentrations do not exceed IDLH levels.

   - Atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any body area left unprotected by chemical-resistant clothing.

   - Job functions do not require self-contained breathing apparatus.

   - Direct readings are a few ppms above background on instruments such as the FID or PID. (See Appendices I and II.)

3. Guidance on selection

   a. Level C protection is distinguished from Level B by the equipment used to protect the respiratory system, assuming the same type of chemical-resistant clothing is used. The main selection criterion for Level C is that conditions permit wearing air-purifying respirators.

      The air-purifying device must be a full-face respirator (MSHA/NIOSH approved) equipped with a canister suspended from the chin or on a harness. Canisters must be able to

*Optional

remove the substances encountered. Quarter-or half-masks or cheekcartridge, full-face masks should be used only with the approval of a qualified individual.

In addition, a full-face, air-purifying mask can be used only if:

- Substance has adequate warning properties.

- Individual passes a qualitative fit-test for the mask.

- Appropriate cartridge/canister is used, and its service limit concentration is not exceeded.

b. An air surveillance program is part of all response operations when atmospheric contamination is known or suspected. It is particularly important that the air be thoroughly monitored when personnel are wearing air-purifying respirators. Periodic surveillance using direct-reading instruments and air sampling is needed to detect any changes in air quality necessitating a higher level of respiratory protection.

c. Level C protection with a full-face, air-purifying respirator should be worn routinely in an atmosphere only after the type of air contaminant is identified, concentrations measured and the criteria for wearing air-purifying respirator met. To permit flexibility in precribing a Level of Protection at certain environmental incidents, a specialist could consider using air-purifying respirators in unidentified vapor/gas concentrations of a few parts per million above background as indicated by a needle deflection on the FID or PID. However a needle deflection of a few parts per million above background should not be the sole criterion for selecting Level C. Since the individual components may never be completely identified, a decision on continuous wearing of Level C must be made after assessing all safety considerations, including:

   - The presence of (or potential for) organic or inorganic vapors/gases against which a canister is ineffective or has a short service life.

   - The known (or suspected) presence in air of substances with low TLVs or IDLH levels.

   - The presence of particulates in air.

   - The errors associated with both the instruments and monitoring procedures used.

*Optional

- The presence of (or potential for) substances in air which do not elicit a response on the instrument used.

- The potential for higher concentrations in the ambient atmosphere or in the air adjacent to specific site operations.

d. The continuous use of air-purifying respirators (Level C) must be based on the identification of the substances contributing to the total vapor or gas concentration and the application of published criteria for the routine use of air-purifying devices. Unidentified ambient concentrations of organic vapors or gases in air approaching or exceeding a few ppm above background require, as a minimum, Level B protection.

D. Level D Protection

1. Personnel protective equipment

   - Coveralls

   - Gloves*

   - Boots/shoes, leather or chemical-resistant, steel toe and shank

   - Safety glasses or chemical splash goggles*

   - Hard hat (face shield)*

2. Criteria for selection

   Meeting any of these criteria allows use of Level D protection:

   - No contaminants are present.

   - Work functions preclude splashes, immersion, or potential for unexpected inhalation of any chemicals.

   Level D protection is primarily a work uniform. It can be worn only in areas where there is no possibility of contact with contamination.

*Optional

APPENDIX G-C

PERSONAL AIR MONITORING PROGRAM
DURING REMEDIAL CONSTRUCTION

PERSONAL AIR MONITORING PROGRAM DURING REMEDIAL CONSTRUCTION

1.0 INTRODUCTION

The initial phases of the Remedial Work involve site grading and smoothing and placement of the first layer of sand/soil cover. The air monitoring program outlined herein and in QAPP-3 (Attachment C3) will be implemented during these initial phases of the Remedial Work. The ambient air monitoring program is presented in Appendix C3-B and the personal air monitoring program is presented herein. The air monitoring is to be conducted to satisfy the requirements of the December 31, 1987 Consent Decree.

2.0 OBJECTIVES

It is intended that Remedial Activities be carried out such that asbestos concentrations in the breathing zone of on-site personnel do not exceed permissible time-weighted average exposure concentrations.

3.0 PROPOSED PERSONAL AIR MONITORING PROGRAM

The proposed methods and equipment to be used for personal monitoring are presented herein.

3.1 Monitoring Plan

Personal monitoring for airborne asbestos will be conducted by the Remedial Work Contractor according to the procedure described in the June 20, 1986 Federal Register. In this method, air is drawn at a rate of approximately 0.5 to 2.5 liters per minute through mixed cellulose ester filters (0.8 um pore size and 25/37 mm diameter) mounted in open-faced cassettes over a full workshift duration. Constant-flow personal air sampling pumps will be used which will be calibrated with a primary standard prior to and following use. During workdays, individuals representing various working groups will be fitted with the sampling pumps (on their belts) and the filter cassettes will be attached to their lapels, (i.e., in their breathing zones). The filter cassettes will be returned to the laboratory daily for selected analysis by Optical Phase Contrast Microscopy (PCM).

Four personal samples will be taken daily; one from each of the four different working groups (i.e., truck drivers, scraper operators, backhoe/bulldozer operators and laborers). The selection of individuals from groups will be based upon those most likely to be exposed to asbestos fibers during the day. The installation of sampling equipment on individuals will be done on a daily basis by the Contractor's Site Safety Officer. Four additional samplers (ready for operation) will be available on-site for use on the following day of measurements. At the end of the workday, samplers will be removed and, after a review of the daily activities, two samples (filter cassettes) will be selected for PCM analysis based on the potential for greatest exposure.

It is anticipated that, on most occasions, analytical results will be available the next working day following sampling. The results will be recorded as airborne concentrations (# fibers >5 um/cc of air) and provided each day to Manville's Remedial Construction Manager. These results will then be compared to the permissible time-weighted average exposure concentrations of 0.2 fibers/cc. For each set of weekly sample filters, two blank filters will be prepared and loaded into cassettes in a similar fashion to sample filters. Of these, one blank filter will also be analyzed. All remaining unanalyzed filters will be retained by the Remedial Work Contractor.

3.2 Sample Handling and Storage

Throughout the program filters will be loaded in individual filter cassettes in a clean room. Samples (cassettes) will be clearly identified, marked and recorded. Filter cassettes will be taken to the site and stored with caps during overnight intervals prior to sampling. All exposed filter cassettes will be capped after sample collection and hand carried or transported to the laboratory using precautions to minimize dislodgment of collected material. All collected samples and blanks will be stored until completion of air monitoring program by Manville and/or completion of Remedial Construction. Appropriate precautions will be taken to avoid contamination during all sample handling and storage.

3.3 Sample Analysis

Samples will be analyzed using optical PCM methods in accordance with the procedures outlined in the June, 1986 Federal Register for measuring airborne asbestos fibers.

3.4 Data Reporting

Daily reporting of analytical results from selected personal samples to the Manville Remedial Construction Manager will be done on the working day following sample collection. These will be communicated to U.S. EPA and IEPA by telephone or otherwise when received. Summaries of monitoring activities and data will be reported monthly to Manville by the Contractor. Summary Report from the Contractor will include raw data from sample analysis. Manville will include such summaries in the monthly progress report. A final report at the completion of the monitoring program will be prepared by Manville which will include: a description of sampling and analytical methods, any problems encountered, summarized monitoring data and the significance of results. Raw data from sample analysis will form an appendix to the report. This report will be submitted to U.S. EPA and IEPA.

4.0 PROJECTED WORK SCHEDULE

It is projected that the initial phases of the remedial activities requiring air monitoring will commence within 30 calendar days of the award of the construction contract and be completed after a period of five to six months. Personal air monitoring will be scheduled to coincide with these activities. It is anticipated that the final report will be completed within approximately 60 calendar days after completion of the personal air monitoring program.

APPENDIX F

VISIBLE EMISSION STANDARDS CHANGE

VISIBLE EMISSION STANDARDS CHANGE

CHANGES TO THE "NO VISIBLE EMISSIONS" STANDARD REQUIRED TO ALLOW THE SITE WORK TO PROCEED WHILE ATTAINING THE OBJECTIVES OF THE PROJECT (MINIMIZING AND CONTROLLING ASBESTOS EMISSIONS). (12/14/88)

The following agreed to changes replace the "No Visible Emissions" **Standard, wherever it is unattainable. <u>Noncompliance will result in work shut down.</u>**

1. The amount of materials to be disturbed shall be minimized. Miscellaneous plant waste shall be used as fill, as available, in lieu of contaminated materials.

2. Work area size shall be controlled to allow contouring and placement of sand cover in a reasonable minimum timeframe, minimizing the amount of open area available to erode in the wind. A three week cycle is the goal, from opening to closing (with sand), of the selected site.

3. When cuts are to be made in bluffs or berms, to the greatest extent possible the work shall be done on the leeward side, with water truck support.

4. Materials that have been cut and rough graded shall be smoothed and treated with a dust suppressant, (water acceptable), as required to control emissions. If the opened area of the phase of the project currently being worked becomes dry and dusty at any time, a suppressant shall be applied.

5. Road emissions from roads, which have been impacted by remedial construction shall be controlled through use of a suppressant until such time as initial cover is in place. A visible plume in back of a vehicle is unacceptable.

6. Regarding dust suppressants-try water first; if not effective, use chemical based suppressants, as appropriate, after having obtained approval from USEPA and the owner, regarding the toxicity characteristics of the product, before use.

7. When cutting a new surface, use an effective dust suppressant on the surface prior to cutting.

8. When cutting with either bulldozer or backhoe on a face where materials can tumble, take all possible steps to avoid materials drop. Never proceed with this work without use of the water truck, as a minimum. To the greatest extent possible, work to the lee side of the pile.

VISIBLE EMISSION STANDARDS CHANGE

CHANGES TO THE "NO VISIBLE EMISSIONS" STANDARD REQUIRED TO ALLOW THE SITE WORK TO PROCEED WHILE ATTAINING THE OBJECTIVES OF THE PROJECT (MINIMIZING AND CONTROLLING ASBESTOS EMISSIONS). (12/14/88)

9. Where possible, work steep banks at an angle that will allow the use of sand cover, rather than using clay...thus allowing closure of the open area in the shortest possible schedule.

10. When the option of cutting with a cat versus a backhoe is available, choose the use of the cat. The compaction that results from blading also results in greatly reduced possibility of emissions.

11. Avoid trucking excavated materials, if possible.

12. When using a backhoe, rotate the loaded bucket to the unload area by carrying as low as possible...thus reducing possible emissions.

13. When using a backhoe, the dump cycle should commence with the bucket essentially in contact with the dump site. On rotation of the bucket, while dumping, the materials will be spread onto the dump site rather than dropped from a height.

14. Use only the amount of suppressant that is necessary to achieve emission control. Avoid excessive wetting of material.

15. This program will be reevaluated if found to be ineffective by field observations or perimeter monitoring results.

TITLE President L.C.G.C. DATE 12/19/88 APPROVAL LCG [signature]

TITLE Remed. Const. Mgr DATE 12/19/88 APPROVAL MANVILLE [signature]

TITLE On-Site Coord. DATE 12/16/88 APPROVAL USEPA Brad W Bradley

CC: LCG (LAKE COUNTY GRADING)
MANVILLE
USEPA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY)
M. Clumpus WHQ-6-04
G. Davis Remedial Site Manager
B. Bradley, US EPA On Site Coordinator

APPENDIX G

DECONTAMINATION PROCEDURE

To: All Employees
Date: November 30, 1988
From: G.C. Davis

DECON PROCEDURES

1. The safety and health of all employees must be our first consideration. Proper use of the facilities will protect us all.

2. No person wearing contaminated clothing shall enter the "clean" end of the Decon Trailer

3. In preparation for entering those areas of the site requiring Class C Protection one shall enter the "clean" end of the Decon Trailer, disrobe completely, leaving all clothing in a locker.

4. Pass through the shower section, assemble and don your respirator, then pass to the "contaminated end" of the Decon Trailer.

   Here, one shall put on all necessary clothing, including Tyvek suit, gloves, etc. All joints shall be taped with duct tape. Pass out through the door to the work area.

5. On leaving the contaminated area of the site, keep your respirator on! Decontaminate your vehicle. If the vehicle will be used off site, flush out the interior.

6. Hose off gross contamination from boots, Tyveks, etc.

7. Keep your respirator on! Remove and discard all disposable items prior to entering the "contaminated" end of the trailer.

8. Keep your respirator on! Remove and either wash or place in locker all clothing worn on site.

9. Pass to shower area. Remove your respirator and decontaminate after having removed cartridges. Place cartridges in marked storage. Hang respirator.

10. Pass to clean area and put on street clothes.

11. At lunch break, the above procedure shall be followed with the exception that shower and hair wash are optional.

12. Once having entered the "contaminated area", one shall not, under any conditions, enter any trailer without passing thru the "decon" procedure ~~unless an emergency~~ exists.

G.C. Davis

G.C.D.
Remedial Site Manager

APPENDIX H

LAKE COUNTY GRADING COMPANY PERSONNEL AND DECONTAMINATION FACILITY AIR MONITORING DATA

DAILY FIBER COUNT RESULTS

DATE: NOVEMBER 8, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS (FIBERS/CC)	THRESHOLD LIMIT VALUE (FIBER/CC)
DAVE KUHNLEY	11/8/88	LC1411888	.074	.2
MARK MEYER	11/8/88	LC1511888	.005	.2
DAN OLLILA	11/8/88	LC1611888	.005	.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: NOVEMBER 9, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS (FIBERS/CC)	THRESHOLD LIMIT VALVE (FIBER/CC)
DAVE KUHNLEY	11/9/88	LC1411988	.026	.2
MARK MEYER	11/9/88	1C1511988	.028	.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: NOVEMBER 10, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS (FIBERS/CC)	THRESHOLD LIMIT VALVE (FIBER/CC)
DAVE KUHNLEY	11/10/88	LC14111088	.007	.2
MARK MEYER	11/10/88	LC15111088	.18	.2
DAVE KUHNLEY	11/10/88	LC141110882	.011	.2
MARK MEYER	11/10/88	LC151110882	.017	.2
CONTROL	11/10/88	LC111088	1f-100F	.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: NOVEMBER 11, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS (FIBERS/CC)	THRESHOLD LIMIT VALVE (FIBER/CC)
DAVE KUHNLEY	11/11/88	LC14111188	.006	.2
MARK MEYER	11/11/88	LC15111188	.041	.2
CONTROL	11/11/88	1C111188	1f-100F	.2

NOTES:

[illegible]

DAILY FIBER COUNT RESULTS

DATE: 11/12/88

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS (FIBERS/CC)	THRESHOLD LIMIT VALVE (FIBER/CC)
Dave Kuhnley	11-8	LC1411888	.074	.2
Mark Meyer	11-8	LC1511888	.005	.2
Dan Ollila	11-8	LC1611838	.005	.2
Dave Kuhnley	11-9	LC1411988	.026	.2
Mark Meyer	11-9	LC1511988	.028	.2
Dave Kuhnley	11-10	LC14111088	.007	.2
Mark Meyer	11-10	LC15111088	.018	.2
Dave Kuhnley	11-10	LC141110882	.011	.2
Mark Meyer	11-10	LC151110882	.017	.2
Control	11-10	LC111088	1f-100F	.2
Dave Kuhnley	11-11	LC14111188	.005	.2
Mark Meyer	11-11	LC15111188	.018	.2
Dave Kuhnley	11-11	LC141111882	.006	.2
Mark Meyer	11-11	LC151111882	.041	.2
Control	11-11	LC111188	1f-100F	.2

NOTES:

Noted - [illegible]
11/14/88

DAILY FIBER COUNT RESULTS

DATE: NOVEMBER 14, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS (FIBERS/CC)	THRESHOLD LIMIT VALVE (FIBER/CC)
DAVE KUHNLEY	11/14/88	LC14111488	.014	.2
ROB SUNDERMAN	11/14/88	LC5111488	.013	.2
ROB SUNDERMAN	11/14/88	LC51114882	.029	.2
DAVE KUHNLEY	11/14/88	LC141114882	.011	.2

NOTES:

GK

DAILY FIBER COUNT RESULTS

ATE: NOVEMBER 15, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS (FIBERS/CC)	THRESHOLD LIMIT VALVE (FIBER/CC) PER 8 hours
DAVE KUHNLEY	11/15/88	LC14111588	.005	.2
office control	11/15/88	LC111588of	loaded/debris	.2
DAVE KUHNLEY	11/15/88	LC141115882	.011	.2
BRIAN JOHNSON	11/15/88	LC161115881	.012	.2
BRIAN JOHNSON	11/15/88	LC161115882	5f-100F	.2
			(5 fibers/100 fields	

NOTES:

DAILY FIBER COUNT RESULTS

.TE: NOVEMBER 16, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS (FIBERS/CC)	THRESHOLD LIMIT VALVE (FIBER/CC)
DAVE KUHNLEY	11/16/88	LC14111688	.035	.2
BRIAN JOHNSON	11/16/88	LC16111688	.0084	.2
DAVE KUHNLEY	11/16/88	LC141116882	.018	.2
BRIAN KUHNLEY	11/16/88	LC161116882	.007	.2
				Noted

NOTES:

DAILY FIBER COUNT RESULTS

DATE: NOVEMBER 17, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS (FIBERS/CC)	THRESHOLD LIMIT VALVE (FIBER/CC)
DAVE KUHNLEY	11/17/88	LC14111788	.004	.2
BRIAN JOHNSON	11/17/88	LC16111788	.004	.2
MIKE TOWNSEND	11/17/88	LC18111788	.007	.2
BRUCE SHILTS	11/17/88	LC19111788	.005	.2

NOTES:

JD 11/21

DAILY FIBER COUNT RESULTS

DATE: NOVEMBER 18, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI[MIT] FIBER/cc
DAVE KUHNLEY	11/18/88	LC14111888	.005	.2
BRIAN JOHNSON	11/18/88	LC16111888	.005	.2
MIKE TOWNSEND	11/18/88	LC19111888	.0029	.2
CONSTRUCTION OFFICE	11/18/88	LC111888of	.013	.2

NOTES:

11/22 [initials]

DAILY FIBER COUNT RESULTS

DATE: NOVEMBER 21, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
BRIAN JOHNSON	11/21/88	LC16112188	.023	.2
MIKE TOWNSEND	11/21/88	LC18112188	<.011	.2

NOTES: JD. 11/22

DAILY FIBER COUNT RESULTS

DATE: NOVEMBER 22, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
BRIAN JOHNSON	11/22/88	LC16112288	.015	.2
MIKE TOWNSEND	11/22/88	LC18112288	.10	.2
DAN SLOAN	11/22/88	LC20112288	.023	.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: NOVEMBER 23, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
BRIAN JOHNSON	11/23/88	LC16112388	.011	.2
MIKE TOWNSEND	11/23/88	LC18112388	.015	.2
DAN SLOAN	11/23/88	LC20112388	.013	.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: November 25, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Dan Sloan	11/25/88	LC20112588	.014	0.2
Brian Johnson	11/25/88	LC16112588	.017	0.2
Mike Townsend	11/25/88	LC18112588	.052	0.2
Dan Ollila	11/25/88	LC12112588	.014	0.2

NOTES:

11/28

DAILY FIBER COUNT RESULTS

DATE: November 28, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
Ed Litchfield	11/28/88	LC7112888	.025	0.2
Henry Lowes	11/28/88	LC23112888	.052	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: 11/29/88

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
Mike Townsend	11/29/88	LC18112988	.015	.2
Dan Sloan	11/29/88	LC20112988	.018	.2
Henry Lowes	11/29/88	LC23112988	.018	.2

11/30/88

NOTES:

DAILY FIBER COUNT RESULTS

DATE: November 30, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Mike Townsend	11/30/88	LC18113083	.004	0.2
Dan Sloan	11/30/88	LC20113088	.013	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: December 1, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Ron Miller	12/1/88	LC1012188	.019	0.2
Mike Townsend	12/1/88	LC1812188	.007	0.2
Henry Lowes	12/1/88	LC2312188	.004	0.2

NOTES:

JKD.

DAILY FIBER COUNT RESULTS

DATE: December 2, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Mike Townsend	12/2/88	LC1912288	.028	0.2
Henry Lowes	12/2/88	LC2312286	.014	0.2

NOTES:

JCD 12/5/88

DAILY FIBER COUNT RESULTS

DATE: December 3, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Mike Townsend	12/3/88	LC1812388	.020	0.2
Henry Lowes	12/3/88	LC2312388	.034	0.2

NOTES:

12/5/88

DAILY FIBER COUNT RESULTS

DATE: December 5, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Ron Miller	12/5/88	LC1012588	.020	0.2

NOTES:

RD-12/7

DAILY FIBER COUNT RESULTS

DATE: December 6, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Ed Litchfield	12/6/88	LC712688	.031	0.2

NOTES:

JCL - 12/7

DAILY FIBER COUNT RESULTS

DATE: December 7, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Ed Litchfield	12/7/88	LC712788	.030	0.2

JD -12/8/88

NOTES:

DAILY FIBER COUNT RESULTS

DATE: December 8, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI[illegible] FIBER/cc
Ed Litchfield	12/8/88	LC712888	.027	0.2
Bill Fuesting	12/8/88	LC612888	.046	0.2
Decon unit-"Dirty Rm."	12/8/88	LC12888	.009	0.2

NOTES:

gD - 12/14

DAILY FIBER COUNT RESULTS

DATE: December 9, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Bill Fuesting	12/9/88	LC612988	.077	0.2
Ed Litchfield	12/9/88	LC712988	.086	0.2

NOTES:

JD 12/14

DAILY FIBER COUNT RESULTS

DATE: December 12, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Steve Miller	12/12/88	LC4121288	Filter Damaged	0.2
Mike Townsend	12/12/88	LC18121288	.037	0.2
Henry Lowes	12/12/88	LC23121288	050	0.2

NOTES:

RD- 12/14

DAILY FIBER COUNT RESULTS

DATE: December 13, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Mike Townsend	12/13/88	LC18121388	.049	0.2
Henry Lowes	12/13/88	LC23121388	.024	0.2

[illegible] - 12/14/88

NOTES:

DAILY FIBER COUNT RESULTS

DATE: December 14, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Mike Townsend	12/14/88	LC18121488	.035	0.2
Henry Lowes	12/14/88	LC23121488	.057	0.2
Steve Miller	12/14/88	LC4121488	.049	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: December 16, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Henry Lowes	12/15/88	LC23121588	.059	0.2
Area outside - decon clean room door	12/15/88	LC121588	.004	0.2

GD. 12-16.

NOTES:

Only one personal sample was sent for analysis because the others contained sufficient amounts of debris and more than likely determined to be LOADED. The samples for 12/16/88 will be collected at lower flow rates and at for less time in an attempt to lessen the chance of LOADED filters.

DAILY FIBER COUNT RESULTS

ATE: December 16, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Steve Miller	12/16/88	LC4121688	LOADED	0.2
Mike Townsend	12/16/88	LC18121688	.018	0.2
Decon unit-clean rm	12/16/88	LC121688	.013	0.2

NOTES:

QE - 12/20

DAILY FIBER COUNT RESULTS

DATE: December 19/ 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Steve Miller	12/19/88	LC4121988	.015	0.2
Mike Townsend	12/19/88	LC18121988	.005	0.2

NOTES:

12/20

DAILY FIBER COUNT RESULTS

DATE: 12-21-88

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE FIBER/cc
STEVE MILLER	12-21-88	LC4122088 PM	.035	0.2
MIKE TOWNSEND	12-21-88	LC18122088	.018	0.2
HENRY LOWES	12-21-88	LC23122088	.020	0.2

NOTES:

12/21/88

DAILY FIBER COUNT RESULTS

DATE: 12-23-88

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
STEVE MILLER	12-23-88	LC4122188	.049	0.2
MIKE TOWNSEND	12-23-88	LC18122188	.018	0.2
HENRY LOWES	12-23-88	LC23122188	.049	0.2

NOTES:

SAMPLES SHOWN ABOVE ARE 12-21-88 (WORKDAY) RESULTS

D. 12/28

DAILY FIBER COUNT RESULTS

DATE: 12-23-88

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
MIKE TOWNSEND	12-23-88	1000	.026	0.2
DAN SLOAN	12-23-88	1006	.120	0.2

NOTES:

SAMPLES SHOWN ABOVE ARE 12-22-88 (WORK DAY) RESULTS

JD-12/28

DAILY FIBER COUNT RESULTS

DATE: December 23, 1988

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Mike Townsend	12/23/88	LC18122388	.028	0.2
Steve Miller	12/23/88	LC4122388	.028	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: January 3, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
Mike Townsend	1/3/89	LC181389	.052	0.2
Steve Miller	1/3/89	LC41389	LOADED	0.2
Dan Sloan	1/3/89	LC201389	.251	0.2
			GD.	

NOTES:

DAILY FIBER COUNT RESULTS

DATE: January 4, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
Mike Townsend	1/4/89	1007	.039	0.2
Dan Sloan	1/4/89	1009	.077	0.2
Steve Miller	1/4/89	1008	.017	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: January 5, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
M. Townsend	1/5/89	1013	.032	0.2
S. Miller	1/5/89	1014	.021	0.2
D. Sloan	1/5/89	1016	.059	0.2
				940. 1/9/89

NOTES:

DAILY FIBER COUNT RESULTS

DATE: January 6, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
S. Miller	1/6/89	1018	LOADED	0.2
H. Lowes	1/6/89	1019	.092	0.2

NOTES:

LOADED= Loaded with particulate matter, not necessarily loaded with fibers

DAILY FIBER COUNT RESULTS

DATE: January 7, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
M Townsend	1/7/89	1021	Damaged Filter	0.2
S Miller	1/7/89	1022	Damaged Filter	0.2
				1/9

NOTES:

Damaged filters resulted from water entiring the cowl of the cassette

DAILY FIBER COUNT RESULTS

DATE: January 9, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
S Miller	1/9/89	1026	LOADED	0.2
H Lowes	1/9/89	1027	.402	0.2
Decon trailer "Dirty Room"	1/9/89	1029	.040	NA
			PRS -	1/10/89

NOTES:

Loaded does not imply loaded with fibers, but rather loaded with particulate matter

DAILY FIBER COUNT RESULTS

DATE: January 10, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI[illegible] FIBER/cc
S Miller	1/10/89	1031	.043	0.2
Decon Trailer "Clean Rm"	1/10/89	1033	.025	NA
Blank	1/10/89	1034	.5[illegible]/100Fields	0.2
			[illegible] 1/11/89	

NOTES:

DAILY FIBER COUNT RESULTS

DATE: January 11, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
S Miller AM	1/11/89	1038	.032	0.2
H Lowes	1/11/89	1039	.022	0.2
C Campbell	1/11/89	1040	.013	0.2
E Culver (EPA)	1/11/89	1041	.013	0.2
S Miller PM	1/11/89	1042	.030	0.2
			[signature]	1/13/89.

NOTES:

DAILY FIBER COUNT RESULTS

DATE: January 12, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
M Townsend	1/12/89	1043	.010	0.2
S Miller	1/12/89	1044	LOADED	0.2

NOTES:

1044 Loaded with debris- not necessarily fibers

DAILY FILTER COUNT RESULTS

DATE: January 13, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
D Perry	1/13/89	1049	.011	0.2
C Campbell	1/13/89	1050	.013	0.2
H Lowes PM	1/13/89	1051	.013	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: January 16, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE FIBER/cc
M Townsend	1/16/89	1054	.009	0.2
H Lowes	1/16/89	1056	.009	0.2
C Campbell	1/16/89	1057	.010	0.2
Blank #1	1/16/89	1058	0fibers/100F	NA
S Miller	1/16/89	1060	.006	0.2

gd

NOTES:

DAILY FIBER COUNT RESULTS

DATE: January 17, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	1/17/89	1062	.005	0.2
S Miller AM	1/17/89	1063	LOADED	0.2
D Perry	1/17/89	1064	.007	0.2
H Lowes	1/17/89	1065	.005	0.2
S Miller PM	1/17/89	1066	.012	0.2
				JE

NOTES:

Loaded does not necessarily imply loaded with fibers, but rather with particulate matter.

DAILY FIBER COUNT RESULTS

DATE: January 18, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI[illegible] FIBER/cc
S Miller AM	1/18/89	1067	[illegible]	0.[illegible]
Calibration Rm Decon trailer	1/18/89	1068	.005	NA
S MILLER PM	1/18/89	1069	.008	0.2

1/19/89

NOTES:

DAILY FIBER COUNT RESULTS

DATE: January 20, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE FIBER/cc
M Townsend	1/20/89	1071	.024	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: January 20, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE L FIBER/cc
S Miller	1/20/89	1070	.010	0.2

NOTES:

DAILY FIBER COUNT RESU

DATE: February 2, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
S Miller	2/2/89	1075	.008	0.2
H Lowes	2/2/89	1076	.021	0.2
Blank A	2/2/89	1077	0f/100Fields	---
Blank B	2/2/89	1078	1f/100Fields	---
Decon Trailer "Clean Rm."	2/2/89	1079	.010	---

NOTES:

DAILY FIBER COUNT RES

DATE: February 14, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
S Miller	2/14/89	1080	.009	0.2
Decon trailer "Dirty Rm"	2/14/89	1081	.002	0.2
Decon trailer "Calibration Rm"	2/14/89	1082	.002	0.2
Blank #1	2/14/89	1083	0f/100F	---
Blank #2	2/14/89	1084	0f/100F	---

NOTES:

DAILY FIBER COUNT RE

DATE: February 15, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE L. FIBER/cc
S Miller	2/15/89	1085	.007	0.2
Decon trailer shower area	2/15/89	1086	.003	0.2
Decon trailer "Clean Room"	2/15/89	1087	.003	0.2

NOTES:

DAILY FIBER COUNT RES

DATE: February 16, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
M Townsend	2/16/88	1088	.008	0.2
LCGC Office Trailer "Middle section"	2/16/89	1089	.002	0.2
				K.S.

NOTES:

DAILY FIBER COUNT RE

DATE: February 17, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI. FIBER/cc
LCGC Trailer Analyses room	2/17/89	1090	.004	0.2
M Townsend	2/17/89	1091	.007	0.2
F Vinciguerra	2/17/89	1092	.005	0.2

NOTES:

DAILY FIBEL COUNT RES

DATE: February 20, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
M Townsend	2/20/89	1093	.006	0.2
S Miller	2/20/89	1094	.017	0.2
H Lowes	2/20/89	1095	.004	0.2
D LaCrosse	2/20/89	1096	.008	0.2
			gD	

NOTES:

DAILY FIBER COUNT RESUL

DATE: February 21, 1989

EMPLOYEE	DATE	AIR MONITOP SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
M Townsend	2/21/89	1097	.006	0.2
Decon Unit Calibration Room	2/21/89	1098	.003	0.2

NOTES:

DAILY FIBEI COUNT RESUL

DATE: February 22, 19.9

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	2/22/89	1099	.007	0.2
Decon unit Shower area	2/22/89	1100	.004	0.2

NOTES:

DAILY FIBE COUNT R

DATE: February 24, 1989

EMPLOYEE	DATE	AIR MONIT R SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
M Townsend	2/24/89	1101	.012	0.2
Blank #1	2/24/89	1102	1f/100 Fields	---
Blamk #2	2/24/89	1103	0f/100 Fields	---

NOTES:

DAILY FIBER COUNT RESULT

DATE: February 27, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	2/27/89	1104	.011	0.2
Decon Unit "Dirty Rm	2/27/89	1105	.008	0.2
Decon Unit Clean Rm"	2/27/89	1106	.004	0.2
Blank #1	2/27/89	1107	1f/100Fields	---
Blank #2	2/27/89,	1108	0f/100Fields	---

NOTES:

DAILY FIBER COUNT RESULT

DATE: February 28, 19-9

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	2/28/89	1109	.014	0.2
S Miller	2/28/89	1110	.008	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 1, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	3/1/89	1111	.013	0.2
S Miller	3/1/89	1112	.009	0.2
D Perry	3/1/89	1113	.006	0.2
M Mack	3/1/89	1114	.007	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 2, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	3/2/89	1115	.006	0.2
S Miller	3/2/89	1116	.010	0.2
D Perry	3/2/89	1117	.006	0.2
M Mack	3/2/89	1118	.006	0.2

NOTES:

DAILY FI[illegible] COUNT [illegible]

DATE: March 3, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE FIBER/cc
M Townsend	3/3/89	1119	.008	0.2
S Miller	3/3/89	1120	.008	0.2
H Lowes	3/3/89	1121	.007	0.2
D Perry	3/3/89	1122	.007	0.2
LCGC Trailer "Middle"	3/3/89	1123	.002	0.2

NOTES:

DAILY FIBER COUNT L[illegible]

DATE: March 4, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE L FIBER/cc
S Miller	3/4/89	1124	.004	0.2
D Perry	3/4/89	1125	.004	0.2
M Mack	3/4/89	1126	.004	0.2

NOTES:

DAILY FIBER COUNT RESU

DATE: March 6, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
M Townsend	3/6/89	1128	.010	0.2
S Miller	3/6/89	1129	.008	0.2
D Perry	3/6/89	1130	.004	0.2
LCGC Trailer "Analysis Rm"	3/6/89	1131	.002	0.2

NOTES:

DAILY IBE COUNT RESU

DATE: March 7, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
M Townsend	3/7/89	1132	.006	0.2
S Miller	3/7/89	1133	.006	0.2
D Perry	3/7/89	1134	.004	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 8, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
S Miller	3/8/89	1135	.007	0.2
D Perry	3/8/89	1136	.006	0.2
M Mack	3/8/89	1137	.007	0.2
Blank #1	3/8/89	1138	0f/100Fields	---
Blank #2	3/8/89	1139	0f/100Fields	---

NOTES:

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DAILY FIBER COUNT RESULTS

DATE: March 9, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	3/9/89	1140	.007	0.2
H Lowes	3/9/89	1141	.007	0.2
M Mack	3/9/89	1142	.007	0.2

GD.

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 10, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	3/10/89	1143	.004	0.2
S Miller	3/10/89	1144	.007	0.2
Decon Unit "Shower area"	3/10/89	1145	.003	0.2
Decon Unit "Clean Rm"	3/10/89	1146	.003	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 13, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	3/13/89	1147	.005	0.2
S Miller	3/13/89	1148	.007	0.2
Blank #1	3/13/89	1149	2.5f/100Fields	---
Blank #2	3/13/89	1150	1f/100Fields	---
				pd.

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 14, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	3/14/89	1151	.007	0.2
S Miller	3/14/89	1152	.007	0.2
M Mack	3/14/89	1153	.006	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 15, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	3/15/89	1154	.007	0.2
H Lowes	3/15/89	1155	.007	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 16, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
S Miller	3/16/89	1156	.009	0.2
M Mack	3/16/89	1157	.004	0.2
H Lowes	3/16/89	1158	.007	0.2
LCGC Trailer "Middle section"	3/16/89	1159	.004	0.2
				JEL

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 17, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
M Townsend	3/17/89	1160	.011	0.2
H Lowes	3/17/89	1161	.010	0.2
S Miller	3/17/89	1162	.013	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 20, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI[MIT] FIBER/cc
M Townsend	3/20/89	1163	.023	0.2
H Lowes	3/20/89	1164	.011	0.2
Blank #1	3/20/89	1165	1f/100Fields	---
Blank #2	3/20/89	1166	0f/100Fields	---
				JD

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 21, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Inside Manville Command Trailer	3/21/89	032189-TRL	.003	0.2
S Miller	3/21/89	1167	.009	0.2
H Lowes	3/21/89	1168	.017	0.2
				File.

NOTES:

LA LY FIBER COUNT RESULT

DATE: March 22, 1989

EMPLOYEE	DATE	A R MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE L. FIBER/cc
Decon unit- "Dirtv Rm"	3/22/89	1169	.019	0.2
S Miller	3/22/89	1170	LOADED	0.2
Inside Manville trl.	3/22/89	032289-TRL	.007	0.2
			JF	

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 23, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
Inside Manville Tr.	3/23/89	032389-TRL	.002	0.2
M Townsend	3/23/89	1171	.030	0.2
H Lowes	3/23/89	1172	LOADED	0.2

NOTES:

Loaded- not necessarily with fibers, but rather with particulate matter.

DAILY FIBER COUNT RESULTS

DATE: March 24, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Inside Manville Tr.	3/24/89	032489-TRL	.002	0.2
S Miller	3/24/89	1173	.015	0.2
M Mack	3/24/89	1174	.013	0.2
H Lowes	3/24/89	1175	.021	0.2
Decon Unit "Clean Rm"	3/24/89	117[illegible]	.005	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 25, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Inside Manville Tr.	3/25/89	032589-TRL	.005	0.2
S Miller	3/25/89	1177	.008	0.2
H Lowes	3/25/89	1178	.008	0.2

NOTES:

[illegible]

DATE: March 27, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Inside Manville Trailer	3/27/89	032789-Trl	.003	0.2
Field Blank	3/27/89	032789-Blk	1f/100Fields	---
S Miller	3/27/89	1179	.005	0.2
H Lowes	3/27/89	1180	.004	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 28, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE L FIBER/cc
Inside Manville Trailer	3/28/89	032889--TRL	.005	0.2
LCGC Trailer Calib/Analyses Rm.	3/28/89	1181	.004	0.2
LCGC Trailer West end	3/28/89	1182	.003	0.2
Blank #1	3/28/89	1183	0f/100Fields	---
Blank #2	3/28/89	1184	1f/100Fields	---

NOTES:

DAILY FIBER COUNT RESULTS

DATE: March 29, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
Inside Manville Trailer	3/29/89	032989-TRL	.002	0.2
M Townsend	3/29/89	1185	.010	0.2
H Lowes	3/29/89	1186	.017	0.2

NOTES:

DAILY FIB[illegible] COUNT RESULT

DATE: March 30, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE L FIBER/cc
Inside Manville ~~Trailer~~	3/30/89	CCJ&M 033089-TRL	.003	0.2
S Miller	3/30/89	118?	Water Damaged	0.2
H Lowes	3/30/89	1188	.006	0.2

NOTES:

Water Damaged: filter saturated with water, unable to analyze.

DAILY FIBER COUNT RESULTS

DATE: March 31, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
Inside Manville Trailer	3/31/89	CCJ&M 033189-TRL	.002	0.2
				[illegible]

NOTES:

[illegible]

DATE: April 1, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE L. FIBER/cc
M Townsend	4/1/89	1189	.008	0.2
S Miller	4/1/89	1190	.010	0.2
				GCG

NOTES:

DAILY FIBER COUNT RESULTS

DATE: April 3, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	4/3/89	1191	.006	0.2
H Lowes	4/3/89	1193	.005	0.2
Blank #1	4/3/89	1194	0f/ 100Fields	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: April 3, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
Manville Trailer	4/3/89	CCJ&M 040389-TRL	.002	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: April 4, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/4/89	CC&M 040489-TRL	.007	0.2
M Townsend	4/4/89	1196	.006	0.2
S Miller	4/4/89	1197	.004	0.2
Decon Trailer "Clean Rm"	4/4/89	1198	.008	0.2
Decon Trailer "Calib. Rm"	4/4/89	1199	.004	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: April 5, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/5/89	CCJ&M 040589-TRL	.006	0.2
M Townsend	4/5/89	1200	.012	0.2
S Miller	4/5/89	1201	.018	0.2
H Lowes	4/5/89	1202	.029	

NOTES:

DAILY FIBER COUNT RESULT

DATE: April 6, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Manville Trl	4/6/89	CCJ&M 040689-TRL	.003	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: April 7, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM. FIBER/cc
Manville Trl	4/7/89	CCU&M 040789-TRL	.003	0.2
S Miller	4/7/89	1207	.015	0.2
H Lowes	4/7/89	1208	.018	0.2
				GL

NOTES:

189-2-

DAI[illegible] FIB[illegible] [illegible]

DATE: April 8, 1989

EMPLOYEE	DATE	[illegible] MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE L FIBER/cc
Manville Trailer	4/8/89	CCJ [illegible] 040889-[illegible]RL	.002	0.2
S Miller	4/8/89	1209	.024	0.2
H Lowes	4/8/89	1210	LOADED	0.2
Decon Unit- Shower area	4/8/89	1211	.007	0.2

NOTES:

DAILY FIBER COUNT RECAP

DATE: April 10, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE FIBER/cc
Manville Trailer	4/10/89	CC J&M 041089--TRL	.006	0.2
H Lowes	4/10/89	1212	.015	0.2
M Mack	4/10/89	121[illegible]	.007	0.2
			JL	

NOTES:

DAILY FIBER COUNT LOG

DATE: April 11, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE FIBER/cc
Manville-Blank	4/11/89	CCJ&M 041189-BLK	0f/100 Fields	---
Manville Trailer	4/11/89	CCJ&M 041189-TRL	.005	0.2
S Miller	4/11/89	1216	.005	0.2
H Lowes	4/11/89	1217	LOADED	0.2
Blank #1	4/11/89	1219	1f/ looFields	---
			JO	

NOTES:

DAILY FIBER COUNT RESULT

DATE: April 12, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE L FIBER/cc
Manville Trailer	4/12/89	CCJ&M 041289-TRL	.005	0.2
S Miller	4/12/89	1221	.017	0.2
H Lowes	4/12/89	1222	LOADED	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: April 13, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
J Cruz	4/13/89	1224	LOADED	0.2
D Perry	4/13/89	1226	.010	0.2
Decon Unit- "Dirty Rm"	4/13/89	1227	.007	0.2

NOTES:

[illegible]

DATE: April 13, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/13/89	CCJ&M 041389-CRL	.003	0.2

NOTES:

DAILY FIBER COUNT REPORT

DATE: April 14, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/14/89	CCJ& M 041489-TRL	.007	0.2

NOTES:

DAILY FIBER COUNT RESULT

RE: April 14, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	4/14/89	1228	.008	0.2
H Lowes	4/14/89	1229	.016	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: April 15, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
H Lowes	4/15/89	1232	LOADED	0.2
S Miller	4/15/89	1233	.012	0.2
Decon Unit- "Clean Room"	4/15/89	1234	.008	0.2

NOTES:

[illegible]

DATE: April 15, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/15/89	CCJ&M 041589-TRL	.002	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: April 17, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/17/89	CCJ&M 041789-TRL	.007	0.2
H Lowes	4/17/89	1237	.009	0.2
D Perry	4/17/89	1238	.004	0.2
Blank #1	4/17/89	1240	0f/100Fields	---

NOTES:

[illegible]

DATE: April 18, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
S Miller	4/18/89	1242	.013	0.2
H Lowes	4/18/89	1243	.014	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: April 18, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
Manville Trailer	4/18/89	CCJ&M 041889-1RL	.003	0.2
				JP

NOTES:

DAILY FIBER COUNT REPORT

DATE: April 19, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/19/89	041989-TRL	.003	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: April 19, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	4/19/89	1246	.006	0.2
H Lowes	4/19/89	1247	LOADED	0.2
Decon unit- "Calib. Rm"	4/19/89	1249	.004	0.2

NOTES:

[illegible]

DATE: April 20, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/20/89	CCC&M 042089-TRL	.002	0.2
S Miller	4/20/89	1251	.016	0.2
Decon unit- "Shower"	4/20/89	1252	.006	0.2
D Perry	4/20/89	1253	LOADED	0.2

NOTES:

[illegible]

DATE: April 21, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
M Townsend	4/21/89	1255	.020	0.2
H Lowes	4/21/89	1256	LOADED	0.2

NOTES:

DAILY FIBER COUNT RESULT

DATE: April 22, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/22/89	CCJ&M 042289-TRL	.008	0.2
M Townsend	4/22/89	1258	.007	0.2
H Lowes	4/22/89	1261	.006	0.2

NOTES:

DAILY FIBER COUNT RESULT

DATE: April 24, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
M Townsend	4/24/89	1263	LOADED	0.2
M Mack	4/24/89	1264	.007	0.2
Blank #1	4/24/89	1266	0f/100Fields	0.2

NOTES:

"Loaded" implies loaded with particulate matter

[illegible]

DATE: April 25, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville TRAILER	4/25/89	CCJ&M 042589-TRL	.004	0.2
Decon unit- Calib Rm	4/25/89	1272	.007	0.2

NOTES:

Employee samples were not analyzed due to water damage caused by the heavy fog conditions

[illegible]

DATE: April 26, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/26/89	CCJ&M 042689-TRL	.004	0.2
S Miller	4/26/89	1274	.018	0.2
D Perry	4/26/89	1275	.008	0.2

NOTES:

DATE: April 27, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/27/89	CJJ&M 042789 TRL	.003	0.2
M Mack	4/27/89	1277	.004	0.2
H Lowes	4/27/89	1279	.006	0.2

NOTES:

DATE: April 28, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/28/89	CCJ&M 042889-TRL	.003	0.2
H. Lowes	4/28/89	1281	.008	0.2
Decon unit-Calib. Rm	4/28/89	1282	.005	0.2

NOTES:

[illegible]

DATE: April 29, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	4/29/89	CC.I&M 04298)-TRL	.005	0.2

NOTES:

DATE: April 29, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
D Perry	4/29/89	1285	LOADED	0.2
M Townsend	4/29/89	1285	WATER DAMAGE	0.2

NOTES:

Loaded= loaded with particulate matter, not necessarily fibers.

DAILY FIBER COUNT RESULTS

DATE: May 1, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/1/89	CCJ&M 050189-TRL	.006	0.2

NOTES:

[illegible]

DATE: May 2, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Manville Trailer	5/2/89	050289-TRL	.007	0.2
D Perry	5/2/89	1289	LOADED	0.2
M Mack	5/2/89	1290	.004	0.2
Decon unit- "Clean Rm"	5/2/89	1291	.009	0.2

NOTES:

[illegible]

DATE: May 3, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Manville Trailer	5/3/89	CCJ&M 050389-TRL	.012	0.2

NOTES:

[illegible]

DATE: May 3, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
H Lowes	5/3/89	1292	.005	0.2
Blank #1	5/3/89	1293	1f/100Fields	---
M Townsend	5/3/89	1295	.006	0.2

NOTES:

[illegible]

DATE: May 4, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMI FIBER/cc
Manville Trailer	5/4/89	CCJ&M 050489-TRL	.004	0.2
D Perry	5/4/89	1298	LOADED	o.2
M Townsend	5/4/89	1299	WATER DAMAGE	0.2

NOTES:

[illegible]

DATE: May 5, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
S Miller	5/5/89	1301	.006	0.2
D Perry	5/5/89	1302	LOADED	0.2
Manville Trailer	5/5/89	CCJ&M 050589-TRL	.002	0.2

NOTES:

[illegible]

DATE: May 6, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
D Perry	5/6/89	1304	.002	0.2
S Miller	5/6/89	1305	.006	0.2
Manville Trailer	5/6/89	CCJ&M 050689-TRL	.002	0.2

NOTES:

[illegible]

DATE: May 8, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
~~S Miller~~	5/8/89	1308	.007	0.2
~~M Mack~~	5/8/89	1311	.008	0.2
~~Blank #1~~	5/8/89	1312	0f/100Fields	0.2
Decon unit- ~~"Shower"~~	5/8/89	1314	.006	0.2
Manville Trailer	5/8/89	CCJ&M 050889-TEL	.012	0.2

NOTES:

DAILY FIBER COUNT RECORD

DATE: May 9, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/9/89	CCJ&M 050989-TRI	.008	0.2
M Townsend	5/9/89	1315	.006	0.2
H Lowes	5/9/89	1318	.013	0.2

NOTES:

DAILY FIBER COUNT RESULTS

Ce

DATE: May 10, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/10/89	CCJ&M 051089-TRL	.004	0.2
S Ashenfelter	5/10/89	1321	.005	0.2
H Lowes	5/10/89	1322	.005	0.2

NOTES:

[illegible]

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DATE: May 11, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	5/11/89	1324	.016	0.2
M Mack	5/11/89	1326	LOADED	0.2

NOTES:

DAILY FIBER COUNT RECORD

DATE: May 11, 1989

Wk

EMPLOYEE	DATE	AIR MONITG SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/11/89	CCJ&M 051189-TRL	.008	0.2

NOTES:

DAILY FIBER COUNT RESULTS

DATE: May 12, 1989

EMPLOYEE	DATE	AIR MONITORING SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/12/89	CCC&M 051289-PRL	.008	0.2
M Townsend	5/12/89	1327	.019	0.2
S Ashenfelter	5/12/89	1328	.024	0.2

NOTES:

DATE: May 13, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/13/89	CCJ&M 051389-TRI	.010	0.2
S Dowell	5/13/89	1331	.010	0.2
M Mack	5/13/89	1332	.007	0.2

NOTES:

[illegible]

DATE: May 15, 1989

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EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULT FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/15/89	CCJ&M 051589-TRL	.011	0.2

NOTES:

[illegible]

Wh

DATE: May 15, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	5/15/89	1335	.012	0.2
S Miller	5/15/89	1336	LOADED	0.2
Blank #1	5/15/89	1339	0f/100Fields	---

NOTES:

DATE: May 16, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/16/89	CCJ& M 051689-TRL	.004	0.2
S Ashenfelter	5/16/89	1341	.006	0.2
H Lowes	5/16/89	1342	.010	0.2

NOTES:

DATE: May 17, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
H Lowes	5/17/89	1346	.007	0.2
D Perry	5/17/89	1347	.008	0.2

NOTES:

[illegible]

DATE: May 17, 1989

Wr

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/17/89	CCJ&M 051789-CRL	.003	0.2

NOTES:

[illegible]

DATE: May 18, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM. FIBER/cc
Manville Trailer	5/18/89	CCJ&M 051889-TRL	.004	0.2
M Townsend	5/18/89	1349	.006	0.2
D Perry	5/18/89	1351	.007	0.2

NOTES:

DAILY FIBER [illegible] RESULTS

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DATE: May 19, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/19/89	CCJ&M 051989-TRL	.002	0.2
~~S Miller~~	5/19/89	1355	.004	0.2
H Lowes	5/19/89	1356	.013	0.2

NOTES:

DATE: May 20, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	ACTUAL FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trailer	5/20/89	CCJ&M 052089-TRL	.002	0.2
H Lowes	5/20/89	1359	.004	0.2
S Ashenfelter	5/20/89	1360	.006	0.2

NOTES:

DATE: May 22, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
M Townsend	5/22/89	1362	.004	0.2
S Dowell	5/22/89	1363	.007	0.2
Decon unit "Clean Room"	5/22/89	1364	.006	0.2
Blank #1	5/22/89	1365	½f/100Fields	~~0.2~~

NOTES:

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DATE: May 23, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Manville Trailer	5/23/89	CCJ& 4 052389 -1RL	.002	0.2
S Ashenfelter	5/23/89	1367	.007	0.2
S Miller	5/23/89	1363	.003	0.2
Inside Dredge	5/23/89	1370	.008	0.2

NOTES:

DATE: May 24, 1989

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EMPLOYEE	DATE	AIR MONITOR SAMPLE	[illegible] FIBERS/[illegible]	PERMISSIBLE EXPOSURE LI[illegible] FIBER/cc
Manville Trailer	5/24/89	CCJ&M 052489-TRL	.001	0.2
M Townsend	5/24/89	137[illegible]	.011	0.2
S Miller	5/24/89	137[illegible]	.008	0.2

NOTES:

DATE: May 25, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
Manville Trailer	5/25/89	CCJ&M 052589-TRL	.002*	0.2
H Lowes	5/25/89	1375	.006	0.2
S Ashenfelter	5/25/89	1376	.004	0.2
Decon unit- "Clean Room"	5/25/89	1377	.005	0.2

NOTES:

* very little particulate matter on this filter

[illegible]

DATE: May 26, 1989

EMPLOYEE	DATE	[illegible] SAMPLE #	RESULTS FIBERS/[illegible]	PERMISSIBLE EXPOSURE LIM FIBER/cc
Manville Trailer	5/26/89	CCJ&M 052689-TRL	.003	0.2
H Lowes	5/26/89	1379	.017	0.2
K Harvey	5/26/89	1380	LOADED	0.2

NOTES:

DATE: May 30, 1989

EMPLOYEE	DATE	[illegible] SAMPLE #	[illegible] FIBERS/cc	PERMISSIBLE EXPOSURE LI[illegible] FIBER/cc
Manville Trailer	5/30/89	CCJ[illegible]M 053089-TLL	.002	0.2
H Lowes	5/30/89	138[illegible]	.007	0.2
M Townsend	5/30/89	1383	.006	0.2
Blank #1	5/[illegible]0/89	1386	0f/100Fields	0.2

MAY 3 1 [illegible]

NOTES:

DATE: May 31, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	[illegible]	PERMISSIBLE EXPOSURE L... (F/CC)
Manville Trailer	5/31/89	CCJ&M 053189_TRL	.002	0.2
H Lowes	5/31/89	1390	.015	0.2
M Townsend	5/31/89	1391	.005	0.2

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NOTES:

[illegible]

[illegible]

DATE: June 1, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
See bottom "Notes"				

NOTES:

No personal air samples were taken today due to heavy rain all day.

[illegible]

JUN 8 [illegible]

DATE: June 2, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
M Townsend	6/2/89	1392	.007	0.2
Decon unit- "Shower area"	6/2/89	1393	.002	0.2
S Miller	6/2/89	1394	.008	0.2

NOTES:

JUN 8 REC'D

DATE: June 3, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
M Townsend	6/3/89	1395	.015	0.2
S Miller	6/3/89	1396	.003	0.2
				50

NOTES:

[illegible]

JUN 8 [illegible]

DATE: June 5, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
L Tadd	6/5/89	1399	.007	0.2
S Ashenfelter	6/5/89	1400	LOADED	0.2
Blank #1	6/5/89	1401	0f/100Fields	0.2
				55

NOTES:

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DATE: June 6, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	[illegible] FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trl.	6/6/89	CCJ&M 060639-TRL	.001	0.2
H Lowes	6/6/89	1403	.007	0.2
S Ashenfelter	6/6/89	1404	.005	0.2

NOTES:

DATE: June 7, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LI FIBER/cc
Manville Trailer	6/7/89	CCJ&4 060739-TRL	.002	0.2
M Townsend	6/7/89	1407	.003	0.2
L Tadd	6/7/89	1409	.014	0.2

NOTES:

[illegible]

DATE: June 8, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIN FIBER/cc
Manville Trailer	6/8/89	CC&M 060889-TRL	.003	0.2
H Lowes	6/8/89	1412	.007	0.2
S Ashenfelter	6/8/89	1413	.013	0.2

NOTES:

CRA/MANVILLE
WAUKEGAN, IL
JUN 26 1989
RECEIVED

DATE: June 9, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	RESULTS FIBERS/cc	PERMISSIBLE EXPOSURE LIM FIBER/cc
Manville Trailer	6/9/89	CCJ&M 060982 IRL	.009	0.2
S Ashenfelter	6/9/89	1415	.006	0.2
H Lowes	6/9/89	1416	.003	0.2

NOTES:

CRA/MANVILLE
WAUKEGAN, IL
JUN 26 1989
RECEIVED

CRA/MANVILLE
WAUKEGAN, IL

JUN 14 1989

RECEIVED

DATE: June 10, 1989

EMPLOYEE	[illegible]	[illegible]	[illegible] FIBER/cc	PERMISSIBLE EXPOSURE LI[illegible] FIBER/cc
Manville Irl	6/10/89	[illegible]	.002	0.2
L Tadd	6/10/89	14 [illegible]	.003	0.2
S Ashenfelter	6/10/89	14 [illegible]	LOADED	0.2
Decon unit- "Dirty Rm."	6/10/89	14.1	.003	0.2

NOTES:

CRA/MANVILLE
WAUKEGAN, IL

JUN 14 1989

RECEIVED

DATE: June 12, 1989

EMPLOYEE	DATE	AIR MONITOR SAMPLE #	[illegible] FIBERS/cc	PERMISSIBLE EXPOSURE LIMIT FIBER/cc
Manville Trl	6/12/89	CCJ&M 061289-TRL	.008	0.2
M Townsend	6/12/89	1422	Water Damage	0.2
L Tadd	6/12/89	1423	Water Damage	0.2
Shed - out by wash pad	6/12/89	1427	.004	0.2

NOTES:

DATE: June 13, 1989

EMPLOYEE							
Manville Trailer		6/13/89	CCJ&H 061389-TRL	.011	0.2		
S Ashenfelter	AM	6/13/89	1429	.005	0.2		
H Lowes		6/13/89	1430	.010	0.2		

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CRA/MANVILLE
WAUKEGAN, IL

JUN 16 1989

RECEIVED

NOTES:

DATE: June 14, 1989

EMPLOYEE	DATE	SAMPLE NO.	ACTIVITY	EXPOSURE LIMIT
Manville Trl	6/14/89	CCJ&I 061489-TRL	LOADED	0.2

CRA/MANVILLE
WAUKEGAN, IL
JUN 16 1989
RECEIVED

NOTES: LCGC did not take personal air samples due to continuous rain.

DATE: June 15, 1989

EMPLOYEE	DATE	[illegible]	[illegible]	PERMISSIBLE EXPOSURE LIMIT
Manville Trl	6/15/89	CCJ&M 061589-TRL	.006	0.2
L Tadd AM	6/15/89	1433	Water Damage	0.2
L Tadd PM	6/15/89	1434	Water Damage	0.2

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CRA/MANVILLE
WAUKEGAN, IL
JUN 16 1989
RECEIVED

NOTES: Continuous rain all day.

DATE: June 16, 1989

EMPLOYEE	DATE			EXPOSURE LIMIT
Manville Trl	6/16/89	CCJ&M 061689-TRL	.014	0.2
No LCGC Personals - Rain/ no Level C work				

CRA/MANVILLE
WAUKEGAN, IL

JUN 24 1989

RECEIVED

NOTES:

CHEM-BIO CORPORATION
ENVIRONMENTAL LABORATORIES

Dear Client,

Enclosed are the results for samples that we received on March 17, 1992.

Account # F333.

KAE DONLEVY
ASBESTOS LABORATORY SUPERVISOR — Kae Donlevy

NADRA BOTROS ______

JIM BROZOWSKI ______

ROBERTA HACKLER ______

CHRIS GIBES ______

JON YAKISH ______

JON EKMAN ______

JILL FREY ______

ADDITIONAL ANALYST ______

FORMER EMPLOYEE ______

If the attached results are being used for the completion of an Inspection and Management Plan, please be sure to enclose this document along with the results. If you have any questions or require any additional information, please feel free to contact us at (414) 764-7005.

Thank you,

CBC ENVIRONMENTAL LABORATORIES

RECE... ...992

CHEM-BIO CORPORATION
ENVIRONMENTAL LABORATORIES

04/21/92 ASBESTOS PAGE 1

LABORATORY REPORT

E333 8472081

FIBER COUNTING - PCM

ECOLOGY SERVICES INC.
1200 MELROSE AVENUE PO BOX 1159
WAUKEGAN ,IL 60079
ATTN: WILL SHERIDAN

CHAIN OF CUSTOC

DATE COLLECTED - 07/26/91 DATE RECEIVED - 03/17/92
LOCATION/PROJECT# 099
(LAKE CO. CORADING)
PROJECT# 099

	SAMPLE VOL (L)	FIBER COUNT (f)	FIELD COUNT	FIBER DENSITY (f/mm2)	FIBER CONC. (f/ml)
CLIENT SAMPLE# 1443					
CBC SAMPLE# 92077-E04921	1485.000	21.0	100.0	26.752	0.007

COMMENTS: AMENDED COLLECTION DATE PER CLIENT 4/20/92. QUALITY CONTROL SAMPLE. NO FIELD BLANK(S) RECEIVED WITH SAMPLES. EXCESSIVE DEBRIS ON FILTER MAY AFFECT ANALYSIS.

SAMPLED BY - ECOLOGY SERVICES INC.
RONALD MILLER
ANALYTICAL METHOD - NIOSH 7400
ANALYST - K. DONLEVY

CBC IS NOT RESPONSIBLE FOR THE RELIABILITY OR ACCURACY OF SAMPLING DATA USED IN CALCULATING RESULTS IF THE SAMPLIN
WAS PERFORMED BY NON-CBC PERSONNEL.

NIOSH MANUAL OF ANALYTICAL METHODS, 3RD EDITION. EPA 40 CFR PART 763; 'INTERIM METHOD FOR THE DETERMINATION OF ASBESTOS IN BULK SAMPLES' TEST METHOD. N/R = NOT RECEIVED
AIHA CERTIFICATE # 53154-001. NVLAP # 1028; PLM AND TEM ACCREDITED. ELAP # 10906.
SAMPLES WILL BE STORED FOR 6 WEEKS BEFORE DISPOSAL UNLESS OTHERWISE SPECIFIED.
IF YOU HAVE ANY QUESTIONS PLEASE CONTACT OUR CLIENT SERVICE DEPARTMENT. APPROVAL NRB
! = REPRINT

CBC
CHEM-BIO CORPORATION
ENVIRONMENTAL
LABORATORIES

04/21/92

ASBESTOS
LABORATORY REPORT

E333 8472081

FIBER COUNTING - PCM

ECOLOGY SERVICES INC.
1200 MELROSE AVENUE PO BOX 1159
WAUKEGAN ,IL 60079
ATTN: WILL SHERIDAN

CHAIN OF CUSTOD'

DATE COLLECTED - 08/08/91 DATE RECEIVED - 03/17/92
LOCATION/PROJECT# 099
(LAKE CO. CORADING)
PROJECT# 099

	SAMPLE VOL (L)	FIBER COUNT (f)	FIELD COUNT	FIBER DENSITY (f/mm2)	FIBER CONC. (f/ml)
CLIENT SAMPLE# 1444					
CBC SAMPLE# 92077-E04922	1320.000	11.0	100.0	14.013	0.004

COMMENTS: AMENDED COLLECTION DATE PER CLIENT 4/20/92. NO FIELD BLANK(S) RECEIVED WITH SAMPLES.

SAMPLED BY - ECOLOGY SERVICES INC.
RONALD MILLER
ANALYTICAL METHOD - NIOSH 7400
ANALYST - K. DONLEVY

CBC IS NOT RESPONSIBLE FOR THE RELIABILITY OR ACCURACY OF SAMPLING DATA USED IN CALCULATING RESULTS IF THE SAMPLIN WAS PERFORMED BY NON-CBC PERSONNEL.

NIOSH MANUAL OF ANALYTICAL METHODS, 3RD EDITION. EPA 40 CFR PART 763; 'INTERIM METHOD FOR THE DETERMINATION OF ASBESTOS IN BULK SAMPLES' TEST METHOD. N/R = NOT RECEIVED
AIHA CERTIFICATE # 53154-001. NVLAP # 1028; PLM AND TEM ACCREDITED. ELAP # 10906.
<u>SAMPLES WILL BE STORED FOR 6 WEEKS BEFORE DISPOSAL UNLESS OTHERWISE SPECIFIED.</u>
IF YOU HAVE ANY QUESTIONS PLEASE CONTACT OUR CLIENT SERVICE DEPARTMENT. APPROVAL __________
! = REPRINT

WAUKEGAN, IL 60085
(708) 33[illegible] [illegible]41

CHAIN OF C[illegible]ODY RECORD

PROJECT NO.	PROJECT NAME		INDUSTRIAL HYGIENE SAMPLE Y / N
099	Manville (Lake Co. Grading)	PARAMETERS	E333
SAMPLERS: (Signature) Ronald [illegible]	(Printed) Ronald Miller		8172081

FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Asbestos							REMARKS 3-17-92 92077
13 1443	3/16/92	4:20pm	/		Pump# 563	1	X							
14 1444	3/16/92	4:20pm	/		Pump# 10728	1	X							~~24 day~~ hr turnaround
														PO# 348461
					4/20/92 collection dates									
					1443 - 7-26-91									
					1444 - 8-8-91									
					per Will Sheridan	60								
					TAS									

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
W Sheridan	3/17/92 9:00	[illegible signature]	[illegible signature]	3/17 1230	Stacy [illegible]
(Printed)		(Printed)	(Printed)		(Printed)

Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks
Stacy [illegible]	3/17/92 1230	To Labs		
(Printed)		(Printed)		

APPENDIX I

DIVERSIFIED ABATEMENT CONTRACTORS, INC.
PERSONNEL AIR MONITORING DATA

RCM LABORATORIES, INC.
ENVIRONMENTAL SERVICES FOR REGULATORY COMPLIANCE & MANAGEMENT

July 18, 1991

Mr. Scott Lindemann
Diversified Abatement Contractors
1616 Belvidere Road
Waukegan, IL 60085

Re: OSHA Air Monitoring
Johns Manville
RCM Project #A910617

Dear Mr. Lindemann:

RCM Laboratories was contracted by Diversified Abatement Contractors to provide OSHA air monitoring at the above referenced project from June 17 through July 12, 1991.

On-site air monitoring was provided by RCM personnel. All air sample analyses were performed utilizing NIOSH Method 7400. The results of the OSHA air monitoring are listed on the attached sheets.

If you have any questions regarding this project, please feel free to contact us at your convenience.

Sincerely,

Susan Donovan

Susan Donovan
Laboratory Manager

SLD/kaj

9431 WEST OGDEN AVENUE BROOKFIELD, ILLINOIS 60513
TEL: 708/485-8600 FAX: 708/485-8607

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 17-Jun-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Y West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Thomas Marlin
ANALYZED BY: Thomas Marlin

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-1			Field Blank		NA	NA				1.5	100		
B-1			Field Blank		NA	NA				0.0	100		
C-1		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	7:58 AM	9:32 AM	94	1.8	169	31.0	100	0.090	0.196
D-1		Debris/CLN	PRS: Axel Anderson 334-30-5175	HM	7:59 AM	9:32 AM	93	1.0	93	5.0	100	0.026	0.075
E-1		Debris/CLN	PRS: Shirley Matthews 333-46-9483 30 Minute Excursion	HM	9:52 AM	10:20 AM	28	1.8	50	1.0	100	0.010	0.054
F-1		Debris/CLN	PRS: Axel Anderson 334-30-5175	HM	9:53 AM	11:54 AM	121	1.0	121	22.5	100	0.091	0.204
G-1		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	10:20 AM	11:54 AM	94	1.8	169	98.0	100	0.284	0.593
H-1		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	1:06 PM	3:22 PM	136	1.8	245	33.5	100	0.067	0.146

Eight Hour Time Weighted Average Personnel Social Security Number	(Fibers/cc)
Shirley Matthews 333-46-9483	0.090
Axel Anderson 334-30-5175	0.015

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: T Marlin

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 19-Jun-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Y West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Ted Dennehy
ANALYZED BY: Ted Dennehy

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-3		Debris/CLN	PRS: Axel Anderson 334-30-5175	HM	6:26 AM	8:55 AM	149	2.2	328	7.5	100	0.011	0.029
B-3		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	6:26 AM	9:26 AM	180	2.0	360	61.5	100	0.084	0.177
C-3		Debris/CLN	PRS: Axel Anderson 334-30-5175	HM	8:55 AM	10:03 AM	68	2.2	150	14.5	100	0.048	0.111
D-3		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	10:02 AM	11:44 AM	102	2.0	204	32.5	100	0.078	0.170
E-3			Field Blank		NA	NA				0.0	100		
F-3			Field Blank		NA	NA				0.0	100		
G-3		Debris/CLN	PRS: Axel Anderson 334-30-5175	HM	10:03 AM	11:10 AM	67	2.2	147	10.0	100	0.033	0.082
H-3		Debris/CLN	PRS: Axel Anderson 334-30-5175 30 Minute Excursion	HM	11:10 AM	11:40 AM	30	2.2	66	17.5	100	0.130	0.297
I-3		Debris/CLN	PRS: Axel Anderson 334-30-5175	HM	12:45 PM	2:00 PM	75	2.2	165	30.5	100	0.091	0.198
J-3		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	12:44 PM	2:00 PM	76	2.0	152	58.0	100	0.187	0.396

Eight Hour Time Weighted Average	
Personnel Social Security Number	(Fibers/cc)
Axel Anderson 334-30-5175	0.040
Shirley Matthews 333-46-9483	0.070

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: T Dennehy

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 20-Jun-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Y North
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Susan Donovan

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-4		Debris/CLN	PRS: Jim Glynn 339-62-7753	HM	6:45 AM	9:25 AM	160	Off		Void	100	Void	
B-4		Debris/CLN	PRS: Duff McCann 335-74-5818 30 Minute Excursion	HM	6:46 AM	7:15 AM	29	2.0	58	2.0	100	**0.017**	0.066
C-4		Debris/CLN	PRS: Duff McCann 335-74-5818	HM	7:15 AM	9:25 AM	130	2.0	260	101.0	100	**0.191**	0.397
D-4		Debris/CLN	PRS: Duff McCann 335-74-5818	HM	10:05 AM	11:55 AM	110	2.0	220	75.0	100	**0.167**	0.351
E-4		Debris/CLN	PRS: Jim Glynn 339-62-7753	HM	10:05 AM	11:55 AM	110	2.2	242	88.0	100	**0.178**	0.373
F-4		Debris/CLN	PRS: Jim Glynn 339-62-7753	HM	12:45 PM	2:10 PM	85	2.2	187	33.5	100	**0.088**	0.191
G-4		Debris/CLN	PRS: Duff McCann 335-74-5818	HM	12:45 PM	2:10 PM	85	2.0	170	27.0	100	**0.078**	0.172
H-4			Field Blank		NA	NA				0.0	100		
I-4			Field Blank		NA	NA				1.0	100		

Eight Hour Time Weighted Average Personnel Social Security Number	(Fibers/cc)
Jim Glynn 339-62-7753	**0.060**
Duff McCann 335-74-5818	**0.100**

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: Susan Donovan

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 21-Jun-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Y West & Y North
JOB #: A -720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Susan Donovan

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-5		Debris/CLN	PRS: Axel Anderson 334-35-5175	HM	6:45 AM	9:30 AM	165	2.5	413	4.5	100	0.005	0.016
B-5		Debris/CLN	PRS: Axel Anderson 334-35-5175	HM	10:00 AM	11:50 AM	110	2.0	220	19.0	100	0.042	0.096
C-5		Debris/CLN	PRS: Axel Anderson 334-35-5175 30 Minute Excursion	HM	12:50 PM	1:20 PM	30	2.0	60	25.0	100	0.204	0.453
D-5		Debris/CLN	PRS: Axel Anderson 334-35-5175	HM	1:20 PM	2:10 PM	50	2.0	100	33.0	100	0.162	0.352
H-4			Field Blank		NA	NA				0.0	100		
I-4			Field Blank		NA	NA				1.0	100		

Eight Hour Time Weighted Average	
Personnel Social Security Number	(Fibers/cc)
Axel Anderson 334-35-5175	0.040

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: Susan Donovan

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 24-Jun-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Y West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Susan Donovan

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-6		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	6:40 AM	9:30 AM	170	1.8	306	23.0	100	**0.037**	0.082
B-6		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	10:00 AM	11:45 AM	105	1.8	189	23.5	100	**0.061**	0.136
C-6		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	12:40 PM	1:10 PM	30	1.8	54	3.5	100	**0.032**	0.100
D-6		Debris/CLN	PRS: Shirley Matthews 333-46-9483 30 Minute Excursion	HM	1:10 PM	2:10 PM	60	1.8	108	7.5	100	**0.034**	0.088
E-6			Field Blank		NA	NA				0.0	100		
F-6			Field Blank		NA	NA				0.0	100		

Eight Hour Time Weighted Average Personnel Social Security Number	(Fibers/cc)
Shirley Matthews 333-46-9483	**0.030**

Key to Abbreviations

ACTIVITY
PREP-site prep
REM-removal
GLBG-glovebag
CLN-clean-up
BGLO-bag load out

SAMPLE TYPE
BK-background
EX-excursion
CL-clearance
FC-final clearance
ENV-environmental
PRS-personal
IC-inside containment
OC-outside containment

RESPIRATOR TYPE
HM-half mask
FF-full face
APR-air purifying respirator
P-powered
SA-supplied air

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: Susan Donovan

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 25-Jun-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Y West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Susan Donovan

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-7		Debris/CLN	PRS: Jim Glynn 339-62-7753	HM	6:15 AM	9:25 AM	190	1.8	342	40.0	100	0.057	0.123
B-7		Debris/CLN	PRS: Jim Glynn 339-62-7753	HM	10:00 AM	11:45 AM	105	1.8	189	36.5	100	0.095	0.205
C-7		Debris/CLN	PRS: Jim Glynn 339-62-7753 30 Minute Excursion	HM	12:45 PM	1:15 PM	30	1.8	54	9.0	100	0.082	0.204
D-7		Debris/CLN	PRS: Jim Glynn 339-62-7753	HM	1:15 PM	2:10 PM	55	1.8	99	7.0	100	0.035	0.091
E-7			Field Blank		NA	NA				0.0	100		
F-7			Field Blank		NA	NA				0.0	100		

Eight Hour Time Weighted Average Personnel Social Security Number	(Fibers/cc)
Jim Glynn 339-62-7753	0.050

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: Susan Donovan

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 26-Jun-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Y North
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Susan Donovan

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-8		Debris/CLN	PRS: Duff McCann 335-74-5818	HM	6:30 AM	9:30 AM	180	1.8	324	58.5	100	0.089	0.187
B-8		Debris/CLN	PRS: Duff McCann 335-74-5818	HM	10:00 AM	11:45 AM	105	1.8	189	24.0	100	0.062	0.138
C-8		Debris/CLN	PRS: Duff McCann 335-74-5818 30 Minute Excursion	HM	12:45 PM	1:15 PM	30	1.8	54	1.0	100	0.009	0.050
D-8		Debris/CLN	PRS: Duff McCann 335-74-5818	HM	1:15 PM	2:00 PM	45	1.8	81	20.0	100	0.121	0.273
E-8			Field Blank		NA	NA				0.0	100		
F-8			Field Blank		NA	NA				0.0	100		

Eight Hour Time Weighted Average Personnel Social Security Number	(Fibers/cc)
Duff McCann 335-74-5818	0.060

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: Susan Donovan

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 27-Jun-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Y North
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Susan Donovan

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-9		Debris/CLN	PRS: Axel Anderson 334-30-5175	HM	6:20 AM	6:50 AM	30	1.8	54	7.0	100	0.064	0.167
B-9		Debris/CLN	PRS: Axel Anderson 334-30-5175	HM	6:50 AM	9:30 AM	160	1.8	288	9.5	100	0.016	0.040
C-9		Debris/CLN	PRS: Axel Anderson 334-30-5175	HM	10:00 AM	11:45 AM	105	1.8	189	20.5	100	0.053	0.120
D-9		Debris/CLN	PRS: Axel Anderson 334-30-5175	HM	12:50 PM	2:10 PM	80	1.8	144	8.0	100	0.027	0.070
E-9			Field Blank		NA	NA				1.0	100		
F-9			Field Blank		NA	NA				0.0	100		

Eight Hour Time Weighted Average	
Personnel Social Security Number	(Fibers/cc)
Axel Anderson 334-30-5175	0.025

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: Susan Donovan

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 28-Jun-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Y North
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Susan Donovan

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-10		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	6:25 AM	9:35 AM	190	2.0	380	39.5	100	0.051	0.110
B-10		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	10:05 AM	11:40 AM	95	2.0	190	56.0	100	0.145	0.306
C-10		Debris/CLN	PRS: Shirley Matthews 333-46-9483	HM	12:45 PM	1:40 PM	55	2.0	110	8.5	100	0.038	0.096
D-10		Debris/CLN	PRS: Shirley Matthews 333-46-9483 30 Minute Excursion	HM	1:40 PM	2:10 PM	30	2.0	60	2.0	100	0.016	0.063
E-10			Field Blank		NA	NA				0.0	100		
F-10			Field Blank		NA	NA				0.0	100		

Eight Hour Time Weighted Average Personnel Social Security Number	(Fibers/cc)
Shirley Matthews 333-46-9483	0.057

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: Susan Donovan

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 1-Jul-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Y North
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Susan Donovan

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-11		Debris/CLN	PRS: Jim Glynn 339-62-7753	HM	6:20 AM	9:30 AM	190	2.0	380	27.0	100	0.035	0.077
B-11		Debris/CLN	PRS: Jim Glynn 339-62-7753 30 Minute Excursion	HM	10:00 AM	10:30 AM	30	2.0	60	23.0	100	0.188	0.419
C-11		Debris/CLN	PRS: Jim Glynn 339-62-7753	HM	10:30 AM	11:50 AM	80	2.0	160	37.5	100	0.115	0.248
D-11		Debris/CLN	PRS: Jim Glynn 339-62-7753	HM	12:45 PM	2:15 PM	90	2.0	180	63.0	100	0.172	0.362
E-11			Field Blank		NA	NA				0.0	100		
F-11			Field Blank		NA	NA				0.0	100		

Eight Hour Time Weighted Average	
Personnel Social Security Number	(Fibers/cc)
Jim Glynn 339-62-7753	0.070

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: Susan Donovan

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 2-Jul-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Z West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Susan Donovan

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-12		Debris/CLN	PRS: Duff McCann 335-74-5818 30 Minute Excursion	HM	6:30 AM	7:00 AM	30	2.0	60	2.0	100	0.016	0.063
B-12		Debris/CLN	PRS: Rick Frank 324-58-7004	HM	7:05 AM	9:35 AM	150	2.0	300	35.0	100	0.057	0.124
C-12		Debris/CLN	PRS: Rick Frank 324-58-7004	HM	10:05 AM	12:45 PM	160	2.0	320	14.0	100	0.021	0.050
D-12		Debris/CLN	PRS: Rick Frank 324-58-7004	HM	12:50 PM	1:20 PM	30	2.0	60	9.0	100	0.074	0.184
E-12		Debris/CLN	PRS: Rick Frank 324-58-7004	HM	1:20 PM	2:10 PM	50	2.0	100	20.0	100	0.098	0.221
F-12			Field Blank		NA	NA				0.0	100		
G-12			Field Blank		NA	NA				0.0	100		

Eight Hour Time Weighted Average	
Personnel Social Security Number	(Fibers/cc)
Duff McCann 335-74-5818	0.001
Rick Frank	0.040

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: Susan Donovan

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 3-Jul-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Z West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Susan Donovan

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-13		Debris/CLN	PRS: Darryl Gay 341-54-7518	HM	6:28 AM	9:00 AM	152	2.0	304	70.0	100	0.113	0.238
B-13		Debris/CLN	PRS: Shawn McGann 345-76-9891	HM	6:30 AM	9:00 AM	150	2.0	300	9.0	100	0.015	0.037
C-13		Debris/CLN	PRS: Darryl Gay 341-54-7518 30 Minute Excursion	HM	9:00 AM	9:30 AM	30	2.0	60	27.5	100	0.225	0.494
D-13		Debris/CLN	PRS: Shawn McGann 345-76-9891 30 Minute Excursion	HM	9:00 AM	9:30 AM	30	2.0	60	4.0	100	0.033	0.099
E-13		Debris/CLN	PRS: Darryl Gay 341-54-7518	HM	10:00 AM	11:50 AM	110	2.0	220	35.0	100	0.078	0.169
F-13		Debris/CLN	PRS: Shawn McGann 345-76-9891	HM	10:00 AM	11:50 AM	110	2.0	220	38.0	100	0.085	0.183
G-13		Debris/CLN	PRS: Darryl Gay 341-54-7518	HM	12:45 PM	2:10 PM	85	2.0	170	25.0	100	0.072	0.160
H-13		Debris/CLN	PRS: Shawn McGann 345-76-9891	HM	12:45 PM	2:10 PM	85	2.0	170	13.5	100	0.039	0.092
I-13			Field Blank		NA	NA				0.0	100		
J-13			Field Blank		NA	NA				0.0	100		

Eight Hour Time Weighted Average Personnel Social Security Number	(Fibers/cc)
Shawn McGann 345-76-9891	0.030
Darryl Gay 341-54-7518	0.080

Key to Abbreviations

ACTIVITY
PREP-site prep
REM-removal
GLBG-glovebag
CLN-clean-up
BGLO-bag load out

SAMPLE TYPE
BK-background
EX-excursion
CL-clearance
FC-final clearance
ENV-environmental
PRS-personal
IC-inside containment
OC-outside containment

RESPIRATOR TYPE
HM-half mask
FF-full face
APR-air purifying respirator
P-powered
SA-supplied air

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: Susan Donovan

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 5-Jul-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Z West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Susan Donovan
ANALYZED BY: Ted Dennehy

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-14		Debris/CLN	PRS: Nolan Seatez 319-66-9437 30 Minute Excursion	HM	6:30 AM	7:00 AM	30	1.5	45	5.5	100	0.060	0.166
B-14		Debris/CLN	PRS: Jim McDermott 350-74-5985 30 Minute Excursion	HM	6:30 AM	7:00 AM	30	1.0	30	7.0	100	0.114	0.300
C-14		Debris/CLN	PRS: Jim McDermott 350-74-5985	HM						Void	100	Void	
D-14		Debris/CLN	PRS: Nolan Seatez 319-66-9437	HM	7:00 AM	10:00 AM	180	1.5	270	24.0	100	0.044	0.097
E-14		Debris/CLN	PRS: Jim McDermott 350-74-5985	HM	10:30 AM	1:40 PM	190	1.0	190	17.0	100	0.044	0.101
F-14		Debris/CLN	PRS: Nolan Seatez 319-66-9437	HM	10:30 AM	1:40 PM	190	1.5	285	Void	100	Void	
G-14			Field Blank		NA	NA				0.0	100		
H-14			Field Blank		NA	NA				0.0	100		

Eight Hour Time Weighted Average	
Personnel Social Security Number	(Fibers/cc)
Jim McDermott	0.025
Nolan Seatez	0.020

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: T Dennehy by

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 8-Jul-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Z West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Ted Dennehy
ANALYZED BY: Ted Dennehy

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-15		Debris/CLN	PRS: Jack Conlisk 321-70-2701	HM	7:29 AM	10:30 AM	181	2.5	453	7.5	100	0.008	0.021
B-15		Debris/CLN	PRS: Shawn McGann 345-76-9891	HM	7:30 AM	10:30 AM	180	2.0	360	11.0	100	0.015	0.036
C-15			Field Blank		NA	NA				0.0	100		
D-15			Field Blank		NA	NA				0.0	100		
E-15		Debris/CLN	PRS: Jack Conlisk 321-70-2701	HM	10:30 AM	2:34 PM	190	2.5	475	25.5	100	0.026	0.058
F-15		Debris/CLN	PRS: Shawn McGann 345-76-9891	HM	10:30 AM	1:07 PM	103	2.0	206	17.0	100	0.040	0.093
G-15		Debris/CLN	PRS: Shawn McGann 345-76-9891	HM	1:07 PM	2:34 PM	87	2.0	174	21.5	100	0.061	0.136

Eight Hour Time Weighted Average Personnel Social Security Number	(Fibers/cc)
Jack Conlisk 321-70-2701	0.013
Shawn McGann 345-76-9891	0.025

Key to Abbreviations

ACTIVITY
PREP-site prep
REM-removal
GLBG-glovebag
CLN-clean-up
BGLO-bag load out

SAMPLE TYPE
BK-background
EX-excursion
CL-clearance
FC-final clearance
ENV-environmental
PRS-personal
IC-inside containment
OC-outside containment

RESPIRATOR TYPE
HM-half mask
FF-full face
APR-air purifying respirator
P-powered
SA-supplied air

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: T Dennehy

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 9-Jul-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Z West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Ted Dennehy
ANALYZED BY: Ted Dennehy

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-16		Debris/CLN	PRS: Ralph Paierski 359-69-9042 30 Minute Excursion	HM	6:19 AM	6:50 AM	31	2.5	78	6.5	100	0.041	0.110
B-16		Debris/CLN	PRS: Darryl Gay 341-54-7518 30 Minute Excursion	HM	6:20 AM	6:50 AM	30	2.0	60	8.5	100	0.069	0.175
C-16		Debris/CLN	PRS: Ralph Paierski 359-69-9042	HM	6:50 AM	11:04 AM	224†	2.5	560	34.5	100	0.030	0.065
D-16		Debris/CLN	PRS: Darryl Gay 341-54-7518	HM	6:50 AM	11:04 AM	224†	2.0	448	23.5	103	0.025	0.057
E-16			Field Blank		NA	NA				0.0	100		
F-16			Field Blank		NA	NA				0.0	100		
G-16		Debris/CLN	PRS: Ralph Paierski 359-69-9042	HM	11:04 AM	2:15 PM	131††	2.5	328	28.5	100	0.043	0.094
H-16		Debris/CLN	PRS: Darryl Gay 341-54-7518	HM	11:04 AM	2:15 PM	131††	2.0	262	15.5	100	0.029	0.067

† 30 minutes for break
†† 60 minutes for lunch

Eight Hour Time Weighted Average	
Personnel Social Security Number	(Fibers/cc)
Ralph Paierski 359-69-9042	0.028
Darryl Gay 341-54-7518	0.024

Key to Abbreviations

ACTIVITY
PREP-site prep
REM-removal
GLBG-glovebag
CLN-clean-up
BGLO-bag load out

SAMPLE TYPE
BK-background
EX-excursion
CL-clearance
FC-final clearance
ENV-environmental
PRS-personal
IC-inside containment
OC-outside containment

RESPIRATOR TYPE
HM-half mask
FF-full face
APR-air purifying respirator
P-powered
SA-supplied air

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: T Dennehy

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 10-Jul-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Z West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Ted Dennehy
ANALYZED BY: Ted Dennehy

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-17		REM	PRS: Nolan Seates 319-66-9473 30 Minute Excursion	HM	6:34 AM	7:00 AM	26	2.0	52	12.5	100	0.118	0.280
B-17		REM	PRS: Nolan Seates 319-66-9473	HM	7:00 AM	11:31 AM	246†	2.0	492	Void		Void	
C-17		REM	PRS: Nolan Seates 319-66-9473	HM	12:43 PM	2:15 PM	92	2.0	560	31.5	100	0.028	0.060
D-17			Field Blank		NA	NA				0.0	100		
E-17			Field Blank		NA	NA				0.0	100		

† 25 minutes for break

Eight Hour Time Weighted Average	
Personnel Social Security Number	(Fibers/cc)
Nolan Seates 319-66-9473	0.022

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: T Dennehy ly

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 11-Jul-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Z West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Ted Dennehy
ANALYZED BY: Ted Dennehy

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-18		REM	PRS: Jamie Olazaba 322-64-9046 30 Minute Excursion	HM	6:23 AM	6:51 AM	28	2.0	56	28.0	100	0.245	0.539
B-18		REM	PRS: Jamie Olazaba 322-64-9046	HM	6:51 AM	10:50 AM	206†	2.0	412	37.0	100	0.044	0.095
C-18		REM	PRS: Jamie Olazaba 322-64-9046	HM	10:50 AM	2:15 PM	143††	2.0	286	75.5	100	0.129	0.272
D-18			Field Blank		NA	NA				0.0	100		
E-18			Field Blank		NA	NA				0.0	100		

† 33 minutes for break
†† 62 minutes for lunch

Eight Hour Time Weighted Average	
Personnel Social Security Number	(Fibers/cc)
Jamie Olazaba 322-64-9046	0.072

Key to Abbreviations

ACTIVITY		SAMPLE TYPE		RESPIRATOR TYPE	
PREP-site prep	CLN-clean-up	BK-background	ENV-environmental	HM-half mask	P-powered
REM-removal	BGLO-bag load out	EX-excursion	PRS-personal	FF-full face	SA-supplied air
GLBG-glovebag		CL-clearance	IC-inside containment	APR-air purifying respirator	
		FC-final clearance	OC-outside containment		

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: T Dennehy ky

RCM Laboratories, Inc.

AIR SAMPLING DATA SHEET
PHASE CONTRAST MICROSCOPY

SAMPLING DATE: 12-Jul-91

CLIENT: Diversified Abatement Contractors
LOCATION: Johns Manville - Area Z West
JOB #: A - 720
RCM PROJECT #: A910617
SAMPLED BY: Ted Dennehy
ANALYZED BY: Ted Dennehy

MAGNIFICATION	400X
FIELD DIAMETER	X
PHASE TEST	X
FIELD AREA	0.00785
INTERLAB C.V.	0.34

RCM SAMPLE #	CLIENT SAMPLE #	DESCRIPTION OF WORK	SAMPLE DESCRIPTION	TYPE OF RESP	TIME START	TIME STOP	SAMPLING TIME (Min)	FLOW RATE (L/Min)	VOLUME (Liters)	TOTAL FIBERS	TOTAL FIELDS	FIBERS PER CC	90% UPPER CONF. LIMIT
A-19		REM	PRS: Shirley Matthews 333-46-9483 30 Minute Excursion	HM	6:42 AM	7:22 AM	40	2.5	100	11.5	100	0.056	0.136
B-19		REM	PRS: Shirley Matthews 333-46-9483	HM	7:22 AM	10:04 AM	162	2.5	405	22.5	100	0.027	0.061
C-19			Field Blank		NA	NA				0.0	100		
D-19			Field Blank		NA	NA				0.5	100		

Eight Hour Time Weighted Average	
Personnel Social Security Number	(Fibers/cc)
Shirley Matthews 333-46-9483	0.014

Key to Abbreviations

ACTIVITY
PREP-site prep
REM-removal
GLBG-glovebag
CLN-clean-up
BGLO-bag load out

SAMPLE TYPE
BK-background
EX-excursion
CL-clearance
FC-final clearance
ENV-environmental
PRS-personal
IC-inside containment
OC-outside containment

RESPIRATOR TYPE
HM-half mask
FF-full face
APR-air purifying respirator
P-powered
SA-supplied air

ALL AIR SAMPLES ARE ANALYZED BY NIOSH METHOD 7400

SIGNATURE OF MICROSCOPIST: T Dennehy

RCM Laboratories, Inc.

APPENDIX J

AIR ASBESTOS MONITORING DURING REMEDIAL ACTION, JULY 1991, C.C JOHNSON AND MALHOTRA, P. C.

AIR ASBESTOS MONITORING DURING REMEDIAL ACTION

AT

THE MANVILLE DISPOSAL AREA

WAUKEGAN, ILLINOIS

JULY 1991

C.C. JOHNSON & MALHOTRA, P.C.
ENVIRONMENTAL ENGINEERS AND SCIENTISTS
Quality Service Since 1979

Grand Rapids, Michigan

CCJM

ENVIRONMENTAL ENGINEERS & SCIENTISTS

JUL 26 1991

SILVER SPRING
CHICAGO
DENVER
GRAND RAPIDS

July 25, 1991

Mr. Richard Shepherd, P.E.
Conestoga, Rovers & Associates
O Hare Corporate Tower 1
10400 West Higgins
Rosemont, IL 60018

RE: "Air Asbestos Monitoring During Remedial Action at the Manville Disposal Area in Waukegan, Illinois"

Dear Mr. Shepherd:

This report summarizes the air monitoring activities conducted at the Manville Disposal Area in accordance with the Remedial Action Work Plan. All air monitoring activities were conducted using procedures outlined in the QAPP. Remedial Action did not impact the quality of air in the surroundings of the site or inside the construction trailer and the dust suppressing measures used during Remedial Construction were effective and adequate.

Please feel free to contact me if you have questions regarding the contents of this report.

Sincerely,

C.C. JOHNSON & MALHOTRA, P.C.

S. K. Malhotra, Ph.D., P.E.
Senior Vice President

C.C. JOHNSON & MALHOTRA, P.C.
3310 EAGLE PARK DR., NE, SUITE 101 • GRAND RAPIDS, MICHIGAN 49505 • (616) 940-2007

1979 Ten Years of Quality Service 1989

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Appendix A: Sampling Locations Selection Letter to U.S. EPA A-1

Appendix B: Asbestos Monitoring Data taken from Monthly Progress Reports B-1

EXECUTIVE SUMMARY:

Air Monitoring at the Manville Disposal Area was conducted in accordance with the Remedial Action Work Plan. It included air monitoring during Pre-Remedial Construction, as well as during initial phases of Remedial Construction involving site clearing, grading, and placing of the first layer of sand/soil cover. Concurrent short-duration (4 - 8 hours) and long-duration (24 hours) monitoring of upwind an downwind construction site perimeter locations as well as short-duration monitoring of construction trailer inside air was conducted. Short-duration sampling data was used to select one downwind location sample on each work day for Transmission Electron Microscopy (TEM) analysis. Except for a small number of total samples collected, the concentration of asbestos fibers observed were below the evaluation criteria of 0.01 fibers/cubic centimeters, or the detection limits. The air monitoring results therefore show that the dust suppressing measures used during the Remedial Construction were effective and adequate, and the Remedial Activities at the Manville Disposal Area did not impact the air quality of the construction trailer and the surroundings of the Remedial Site.

AMBIENT AIR ASBESTOS MONITORING DURING REMEDIAL CONSTRUCTION

1.0 INTRODUCTION

Remedial activities at the Manville Disposal Area were initiated in 1988 in accordance with the Remedial Action Work Plan. An integral part of these activities was an ambient air monitoring program conducted for asbestos before and during Remedial Construction. The air monitoring for asbestos consisted of site perimeter as well as the construction trailer. The monitoring of construction trailer air was added by U.S. EPA after the Remedial Construction had progressed for some time. Both long-duration (24 hours) and short-duration (4-8 hours) concurrent monitoring were conducted at the site perimeter locations. Only short-duration monitoring was conducted of the trailer air. Short-duration monitoring data was used to identify the long-duration air monitoring sample to be analyzed daily by TEM as well as to indicate potential short-duration impacts of Remedial Construction on the surrounding environment. The air monitoring data obtained was used to evaluate potential threat to the surrounding environment of the ongoing Remedial Construction and to assess need of additional dust suppressing measures, if any, to be implemented during Remedial Construction. This report discusses the sampling locations, sampling frequency, sampling and analytical techniques used, the analytical results, evaluation criteria, and conclusions of the ambient asbestos air monitoring conducted during Remedial Action.

2.0 SCOPE OF WORK

The following ambient air asbestos monitoring activities were conducted as specified in the QAPP for the Remedial Action (Pages C3-1 through C3-3):

- AIR SAMPLING BEFORE STARTING REMEDIAL CONSTRUCTION: Ambient air sampling for asbestos was conducted before the start of Remedial Construction (i.e. before the start of clearing and grading activities) for a period of five days to estimate the existing on-site air quality. Five (5) downwind samples (one on each day) were selected for Transmission Electron Microscopy (TEM) asbestos analysis based on predominant wind direction. The data obtained from this sampling event indicated the existing, on-site, airborne asbestos concentrations, if any.

- AIR MONITORING FOR ASBESTOS DURING THE INITIAL PHASES OF REMEDIAL CONSTRUCTION: Initial phases of Remedial Construction activities included clearing, grading and smoothing, and placing the first layer of sand/soil cover on the disposal area. During the initial phases of Remedial Construction, perimeter air monitoring/sampling for asbestos was conducted. This perimeter air sampling involved 24-hour and 4-8 hours sampling on all working days with less than 0.10 inch rain in any 24-hour period.

  Data obtained from the short-duration (4-8 hours) sample analyses by Phase Contrast Microscopy (PCM) method was used to indicate the air quality downwind of the construction activities and as a basis for the selection of perimeter air samples to be analyzed by TEM. The short-duration sample location with the highest fiber loading determined which perimeter location sample was to be tested by TEM.

Field blanks were collected at a rate of one for every ten samples collected.

The above sampling activities were conducted at the site throughout the Remedial Construction period. All sampling procedures and analytical methods used were in accordance with the QAPP.

- MODIFICATIONS/ADDITIONS TO THE AIR MONITORING ACTIVITIES OUTLINED IN THE QAPP: Two modifications/additions were made to the above specified sampling program and areas outlined below:

  1) Pre-remedial Construction perimeter air monitoring was expanded by Manville to include off-site monitoring at two residential area locations west of the site.

  2) Upon U.S. EPA request, monitoring of construction trailer air for asbestos was included in spring of 1989. This additional air sampling was conducted to assure that the personnel using the trailer were not being exposed to asbestos as a result of dirt and dust tracked into the trailer. The trailer air monitoring details were approved by Mr. Brad Bradley of U.S. EPA and met all of the sampling and analytical procedures set forth in the QAPP for the Remedial Construction. Only short-duration (4-8 hours) sampling was conducted of air inside the trailer.

3.0 SAMPLING LOCATIONS

Six on-site and two off-site locations shown in Figures 1 and 2 were selected with the approval of U.S. EPA representative during a site meeting on October 20, 1988 (See letter in Appendix A). Sampling locations which were used during perimeter ambient air sampling events are shown on Figure 1 and off-site locations used during Pre-remedial Construction air sampling are shown on Figure 2. Only three of the locations shown on Figure 1 were sampled on any work day for long-duration and short-duration monitoring. Selection of these sampling locations for long-duration and short-duration perimeter monitoring was dependent upon the prevailing wind direction on a particular working day. Of the three sampling locations, two locations represented conditions downwind of the construction area and one upwind condition. In addition, inside

MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

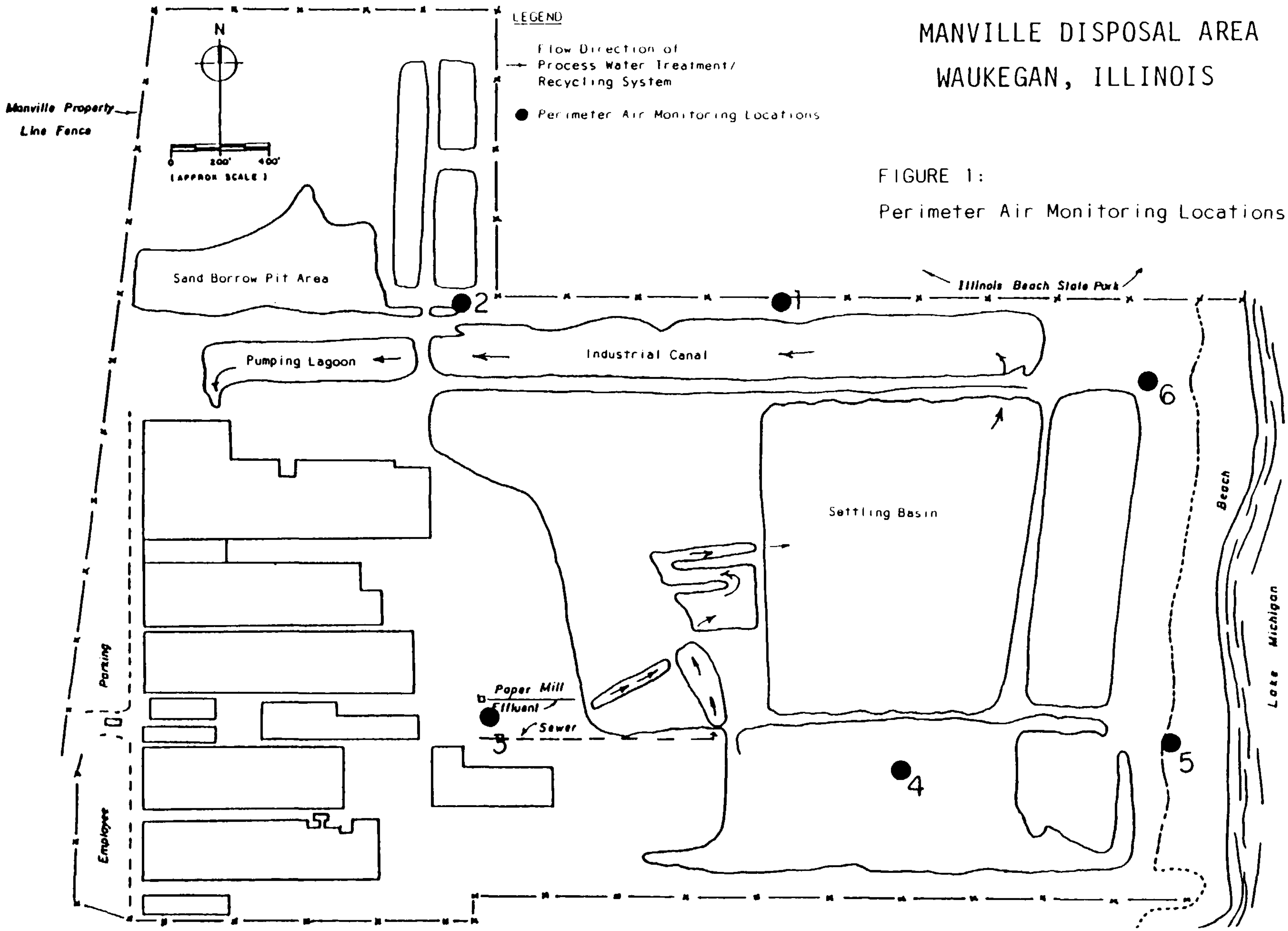
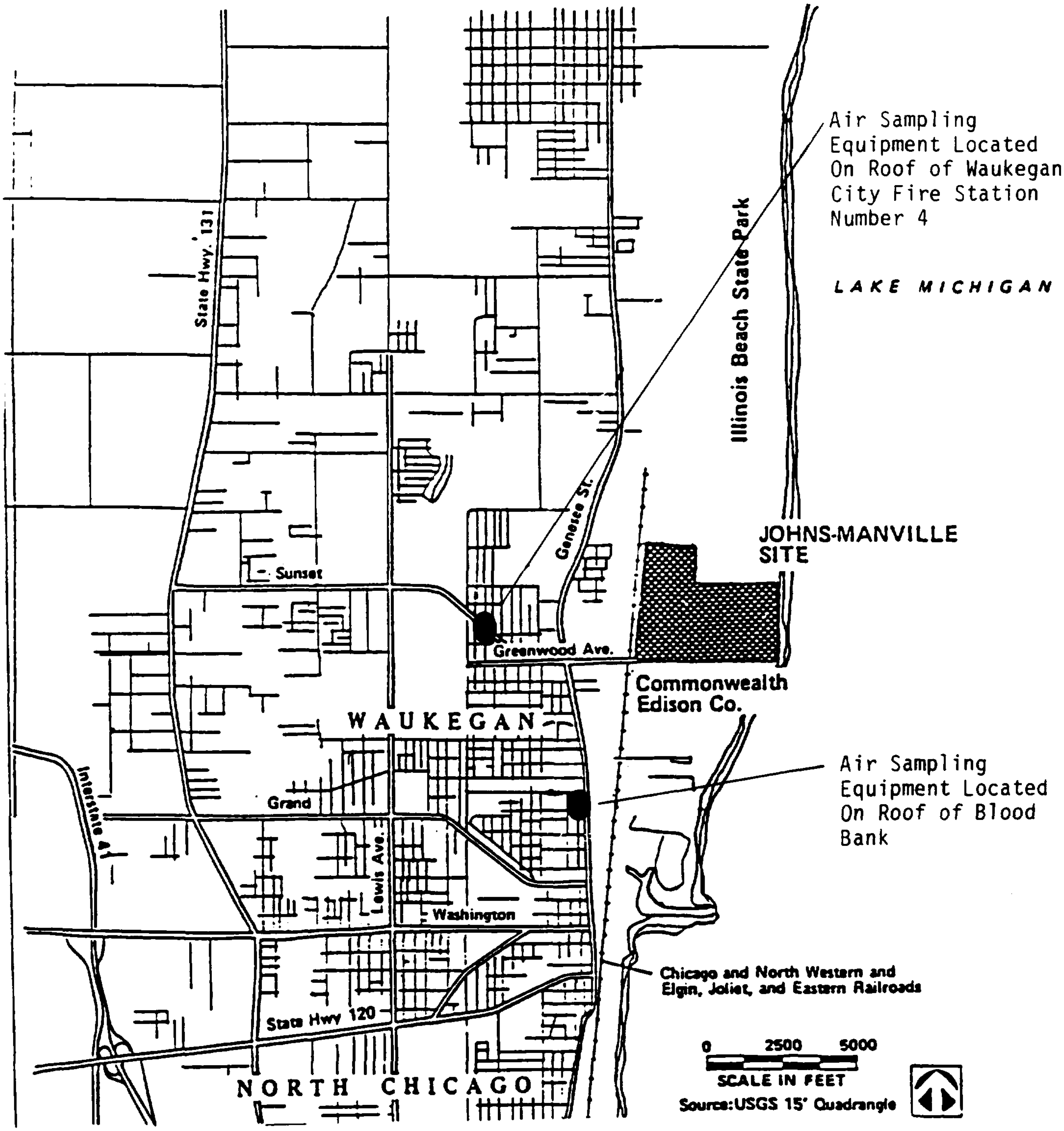


FIGURE 1:
Perimeter Air Monitoring Locations



LEGEND

● OFF-SITE SAMPLING LOCATIONS

Figure 2:
Off-Site Air
Sampling Locations

air of the construction trailer was monitored using short-duration sampling during Remedial Construction. During Pre-Remedial Construction off-site sampling locations shown on Figure 2 were used for short-duration and long-duration sampling.

4.0 STANDARDS AND CRITERIA

The evaluation criteria for any impact on the surrounding environment or for a need of additional dust suppressing measures is in terms of the ambient airborne asbestos concentration at the Manville Remedial Construction Site. As presented in QAPP (Page C3-B-1), it is 0.02 fibers/cubic centimeters by PCM and 0.01 fibers/cubic centimeters by TEM, for fibers greater than 5 microns in length, as well as a comparison with the Pre-Remedial Construction air monitoring data. However, all of the PCM and TEM data obtained were compared to the standard of 0.01 fibers/cubic centimeters.

5.0 SAMPLING PROCEDURES AND METHODOLOGY

Throughout the sampling program measurements of wind speed and direction were made using a portable, battery-operated recording anemometer placed at a height equal to the top of the disposal area. The top of one of the existing Manville Buildings was used to install the anemometer. In addition, wind velocity and direction were measured twice a day using a hand held anemometer at each of the sampling locations.

Portable samplers with pre-calibrated pumps and loaded with cassettes containing MCE filters (0.45 micron pore size) were used for long-duration perimeter air sampling. A total air sample volume of 1,200 to 1,800 liters for a 25 mm filter was used. For short-duration sampling, portable samplers with pre-calibrated pumps and filter cassettes loaded with 25 mm MCE filters were used.

A total air sample volume of approximately 1,200 to 1,800 liters was used for short-duration sampling.

6.0 SAMPLE ANALYSIS

All samples were shipped in cassettes to EMS Laboratory, South Pasadena, California for PCM and TEM analysis as outlined in the QAPP. Both duplicate and replicate analysis were conducted at a rate of one for every ten samples analyzed.

7.0 ANALYTICAL RESULTS

Details of the analytical data obtained from the Ambient Air Asbestos Monitoring have been reported in the monthly progress reports submitted. The asbestos monitoring data from these reports is presented in Appendix B. The data indicated that all observed values for total fibers using PCM were either less than 0.01 fibers/cubic centimeters or non-detected. Also, except for 13 samples, all long-term air monitoring samples analyzed by TEM indicated asbestos concentrations of either less than 0.01 fibers/cubic centimeters or non-detected for asbestos fibers longer than 5 um. The analytical results for the 13 samples containing asbestos concentrations greater than the detection levels are presented in Table 1. It is believed that these detections were caused by trucks passing near a sampling location and creating dust that was captured on the filters. None of the samples collected during Pre-Remedial Construction contained asbestos fibers greater than 0.01 fibers/cubic centimeters.

All observed values inside the construction trailer determined using PCM were either at or less than 0.01 fibers/cubic centimeters or non-detected, except for one sample (Number 110789) which contained 0.03 fibers/cc. This sample was impacted by the sweeping of the trailer. Analytical results for trailer samples at or greater than 0.01 fibers/cc are shown in Table 2.

TABLE 1

SUMMARY OF TEM RESULTS OF REMEDIAL CONSTRUCTION SITE PERIMETER THAT EXCEEDED DETECTION LEVELS
AMBIENT AIR MONITORING FOR ASBESTOS

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results All size fibers/cc	TEM Results Fibers >5um/cc
05-05-89 to 05-06-89	050589-06	3	W-NW	-	0.02
05-08-89 to 05-09-89	050889-03	3	W-NW changing to E-SW	-	0.01
05-11-89 to 05-12-89	051189-04	4	N-NE	-	0.01
05-11-89 to 05-12-89	051189-04D	4	N-NE	-	0.02
05-12-89 to 05-13-89	051289-03R	3	NE	-	0.01
10-02-89 to 10-03-89	100289-06	6	E-NE	0.1	-
10-02-89 to 10-03-89	1000289-06R	6	E-NE	-	0.06
11-17-89 to 11-18-89	112189-03	3	W-SW	0.28	-
08-28-90 to 08-29-90	082890-03	3	N	0.01	-
09-06-90 to 09-07-90	090690-03	3	E	0.04	-
09-12-90 to 09-13-90	091290-02	2	S to W	0.02	-
09-19-90 to 09-20-90	091990-03	3	S-SE	0.015	-
09-25-90 to 09-26-90	092590-03	3	W-SW	0.02	-

D = Duplicate sample
R = Replicate sample

TABLE 2

SUMMARY OF PCM RESULTS OF MANVILLE TRAILER THAT WERE AT OR GREATER THAN 0.01 FIBERS/CC
AMBIENT AIR MONITORING FOR ASBESTOS

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
05-03-89	050389-TRL	Inside Manville Trailer	0.01
05-08-89	050889-TRL	Inside Manville Trailer	0.01
05-14-89	051489-TRL	Inside Manville Trailer	0.01
05-15-89	051589-TRL	Inside Manville Trailer	0.01
11-07-89	110789-TRL	Inside Manville Trailer	0.03
12-01-89	120189-TRL	Inside Manville Trailer	0.01
12-02-89	120289-TRL	Inside Manville Trailer	0.01
09-04-90	090490-TRL	Inside Manville Trailer	0.01
09-10-90	091090-TRL	Inside Manville Trailer	0.01
09-19-90	091990-TRL	Inside Manville Trailer	0.01
10-01-90	100190-TRL	Inside Manville Trailer	0.01

The duplicate and replicate sample results compared favorably with the original sample results. No large or unusual variances were found.

8.0 CONCLUSIONS

Only a small number of the total samples collected during the initial phases of Remedial Construction contained low concentrations of asbestos fibers exceeding 0.01 fibers/cc or the detection levels. Therefore, the Remedial Construction activities related to the Manville Disposal Area did not impact the air quality of the construction trailer air and the surroundings of the Remedial site. The low concentrations of fibers observed during short-duration site perimeter and trailer air sampling further show that the dust-suppressing measures implemented during initial phases of Remedial Construction were effective and adequate in controlling airborne fibers in the immediate surroundings of the remedial site.

APPENDIX A

Sampling Locations Selection Letter to U.S. EPA

JOHNSON & MALHOTRA, P.C.
ENVIRONMENTAL ENGINEERS

October 26, 1988

Mr. Brad Bradley
Remedial Project Manager (5HE-11)
U.S. EPA, Region V
CERCLA Enforcement Section
230 South Dearborn Street
Chicago, Illinois 60604

Re: PERIMETER AIR MONITORING AT JOHNS-MANVILLE DISPOSAL AREA, WAUKEGAN, ILLINOIS

Dear Brad:

This letter presents the locations of air monitoring stations for perimeter monitoring as well as for off-site air monitoring as agreed with Mardi Klevs of your office during the October 20, 1988 Remedial Site meeting. The selected on-site and off-site locations are shown on the attached figures C3-C and C3-A-1. It must be noted that no off-site air monitoring is required during perimeter air monitoring under the Consent Decree. However, Manville plans to conduct limited off-site monitoring prior to remedial construction to obtain background air quality data.

It was also agreed that when a recording anemometer is used, it will be located on top of the "Engineering or B Building" at a height of 3 to 6 feet above the parapet walls of the highest roof of this building.

It was further agreed that valid air monitoring could only be conducted if less than 0.1 inch of rain fell during any (one day) 24 hour monitoring period. If 0.1 inch or greater of rain falls during any 24 hour sampling period, then the next sampling cannot be conducted until a 24-hour period has elapsed after the rain stops.

Please do not hesitate to contact me if you have any questions.

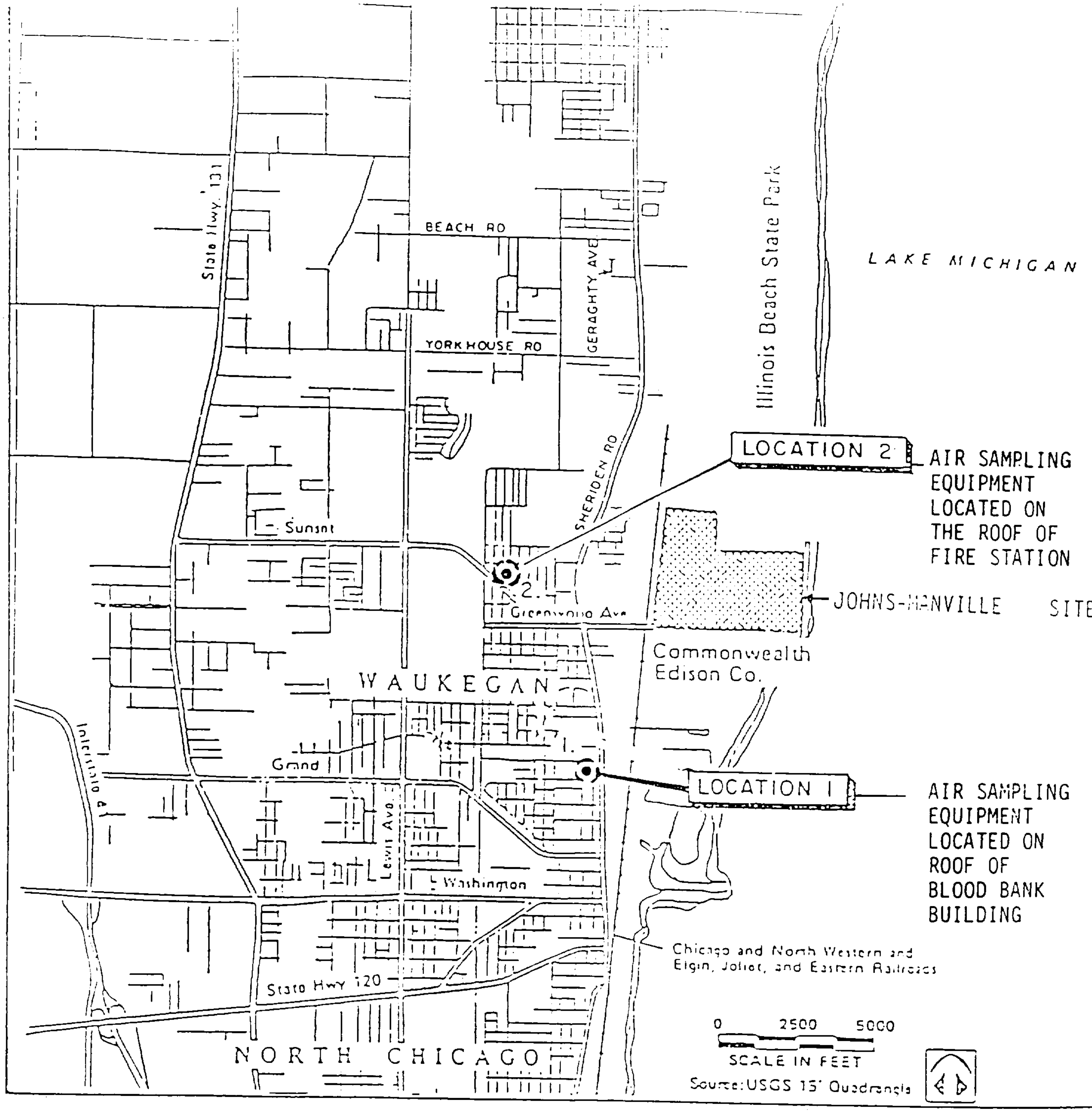
Sincerely,

C.C. JOHNSON & MALHOTRA, P.C.

S.K. Malhotra, Ph.D., P.E.

SKM:net

3310 EAGLE PARK DRIVE, N.E., SUITE # 101 • GRAND RAPIDS, MICHIGAN 49505 • (616) 940-2007



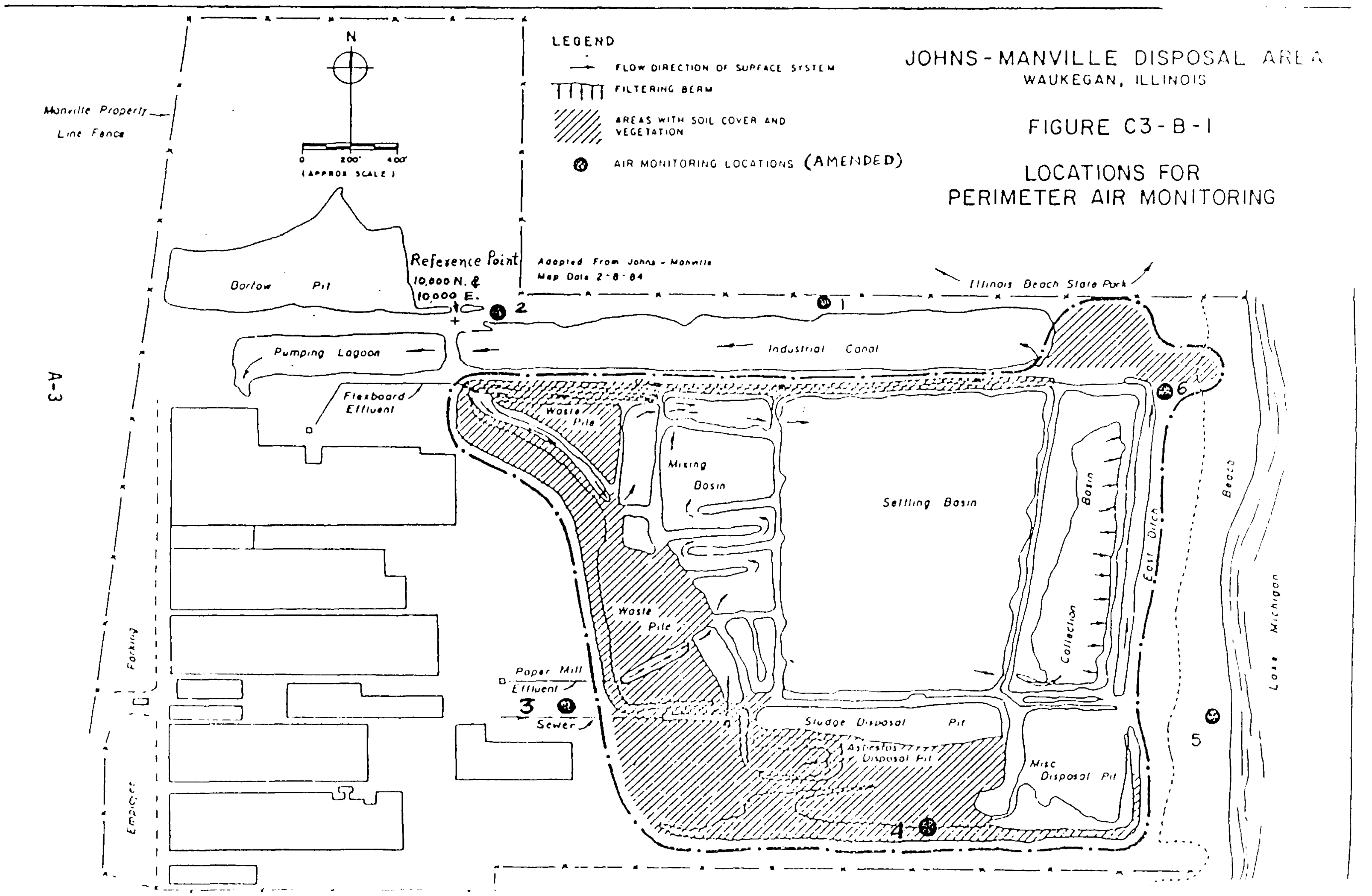
LEGEND

OFF-SITE LOCATIONS

JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

FIGURE 03-A-1

OFF-SITE AIR SAMPLING LOCATIONS
(AMENDED)


JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS
FIGURE C3-B-1
LOCATIONS FOR PERIMETER AIR MONITORING
LEGEND
FLOW DIRECTION OF SURFACE SYSTEM
FILTERING BERM
AREAS WITH SOIL COVER AND VEGETATION
AIR MONITORING LOCATIONS (AMENDED)
N
0 200' 400'
(APPROX SCALE)
Manville Property Line Fence
Borrow Pit
Reference Point 10,000 N. & 10,000 E.
Adopted From Johns - Manville Map Date 2-8-84
Illinois Beach State Park
Pumping Lagoon
Industrial Canal
Flexboard Effluent
Waste Pile
Mixing Basin
Settling Basin
Collection Basin
East Ditch
Beach
Lake Michigan
Parking
Paper Mill Effluent
Sewer
Sludge Disposal Pit
Asbestos Disposal Pit
Misc Disposal Pit
Employee
1
2
3
4
5
6

APPENDIX B

Asbestos Monitoring Data Taken From Monthly Progress Reports

Table 1A

Preliminary Results of Analysis of Ambient Air Monitoring for Pre-Remedial Construction Sampling

Sampling Period	Sample Number	Sample Station Location	PCM Results (Fiber/cc)
10-25 to 10-26, 1988	102588-01	Station - 3	ND
	-02	- 5	ND
	-03	- 4	<0.01
	-04	Roof of Fire Station	ND
	-05	Roof of Blood Bank	ND
10-26 to 10-27, 1988	102688-01	Station - 3	<0.01
	-02	- 5	ND
	-03	- 4	ND
	-04	Roof of Fire Station	ND
	-05	Roof of Blood Bank	ND
10-28 to 10-29, 1988	102888-01	Station - 3	<0.01
	-02	- 5	<0.01
	-03	- 4	<0.01
	-04	Roof of Fire Station	ND
	-05	Roof of Blood Bank	ND
10-29 to 10-30, 1988	102988-01	Station - 3	ND
	-02	- 5	<0.01
	-03	- 4	<0.01
	-04	Roof of Blood Bank	ND
	-05	Roof of Fire Station	ND
10-31 to 11-1, 1988	103088-01	Station - 3	<0.01
	-02	- 5	<0.01
	-03	- 6	<0.01
	-04	Roof of Blood Bank	ND
	-05	Roof of Fire Station	ND
	-06	On-Site Field Blank	ND
	-07	On-Site Field Blank	ND
	-08	Off-Site Field Blank	ND

ND = Not Detected

Table 1B

Summary of Results of Ambient Air Asbestos Monitoring During Remedial Construction

Sampling Period	Sample Number	Sample Station Location	Wind Direction	PCM Res (Fiber
11-28 to 11-29, 1988	112888-01	Station - 3	W-NW	<0.0
	-02	- 4		<0.0
	-03	- 5		ND
	112888 Blank-1	N/A		ND
	112888 Blank-2	N/A		ND
11-29 to 11-30, 1988	112988-03	Station - 3	W-SW	ND
	-04	- 4	Changing to	ND
	-05	- 5	S-SW	ND
11-30 to 12-1, 1988	113088-03	Station - 3	W-NW	ND
	-05	- 5		VOID (cowl fell off)
	-06	- 6		
12-2 to 12-3, 1988	120299-01	Station - 1	W-SW	ND
	-03	- 3		<0.0
	-06	- 6		ND
12-3 to 12-4, 1988	120388-03	Station - 3	W-NW	ND
	-05	- 5		ND
	-06	- 6		ND

ND = Not Detected

Table 2A

Preliminary Results of Analysis of Ambient Air Monitoring for Pre-Remedial Construction Sampling

Sampling Period	Sample Number	Sample Station Location	PCM Results (Fiber/cc)
10-25 to	102588-01	Station - 3	ND
10-26, 1988	-02	- 5	ND
	-03	- 4	<0.01
	-04	Roof of Fire Station	ND
	-05	Roof of Blood Bank	ND
10-26 to	102688-01	Station - 3	<0.01
10/27, 1988	-02	- 5	ND
	-03	- 4	ND
	-04	Roof of Fire Station	ND
	-05	Roof of Blood Bank	ND
10-28 to	102888-01	Station - 3	<0.01
10-29, 1988	-02	- 5	<0.01
	-03	- 4	<0.01
	-04	Roof of Fire Station	ND
	-05	Roof of Blood Bank	ND
10-29 to	102988-01	Station - 3	ND
10-30, 1988	-02	- 5	<0.01
	-03	- 4	<0.01
	-04	Roof of Blood Bank	ND
	-05	Roof of Fire Station	ND
10-31 to	103088-01	Station - 3	<0.01
11-1, 1988	-02	- 5	<0.01
	-03	- 6	<0.01
	-04	Roof of Blood Bank	ND
	-05	Roof of Fire Station	ND
	-06	On-Site Field Blank	ND
	-07	On-Site Field Blank	ND
	-08	Off-Site Field Blank	ND

ND = Not Detected

Table 2B

Preliminary Results of Analysis of Ambient Air Monitoring for Pre-Remedial Construction Sampling

Date	Sample Number	Sample Station Location	TEM Results (Fibers*/cc)	TEM Re (Fibers/cc
10-25 to	102588-03	Station - 4	ND	ND
10-26, 88	-03R		ND	ND
	-04	Roof of Fire Station	ND	ND
	-05	Roof of Blood Bank	ND	ND
10-26 to	102688-01	Station - 3	0.007	ND
10-27, 88				
10-28 to	102888-02	Station - 5	0.01	0.003
10-29, 88				
10-29 to	102988-03	Station - 4	ND	ND
10-31, 88	-03D		ND	ND
10-31 to	103188-03	Station - 6	0.046	0.004
11-1, 88	-06	On-Site Field Blank	ND	ND
	-07	On-Site Field Blank	ND	[illegible]
	-08	Off-Site Field Blank	ND	[illegible]

ND = Not Detected
*Asbestos fibers or structures of all lengths and thicknesses.

Table 2C

Summary of Results of Ambient Air Asbestos Monitoring During Remedial Construction

Sampling Period	Sample Number	Sample Station Location	Wind Direction	PCM Results (Fiber/cc)
11-28 to 11-29, 1988	112888-01	Station - 3	W-NW	<0.01
	-02	- 4		<0.01
	-03	- 5		ND
	112888 Blank-1	N/A		ND
	112888 Blank-2	N/A		ND
11-29 to 11-30, 1988	112988-03	Station - 3	W-SW	ND
	-04	- 4	Changing to	ND
	-05	- 5	S-SW	ND
11-30 to 12-1, 1988	113088-03	Station - 3	W-NW	ND
	-05	- 5		VOID (cowl fell off)
	-06	- 6		ND
12-2 to 12-3, 1988	120299-01	Station - 1	W-SW	ND
	-03	- 3		<0.01
	-06	- 6		ND
12-3 to 12-4, 1988	120388-03	Station - 3	W-NW	ND
	-05	- 5		ND
	-06	- 6		ND

ND = Not Detected

Table 3A

Summary of Results of Ambient Air Asbestos Monitoring During Remedial Construction

Sampling Date	Sample Number	Sample Station Location	Wind Direction	PCM Re (Fibe
12-05-88	120588-03	Station - 3	NW	<0
	-05	- 5	changing	<0
	-06	- 6	to	
	120588 Blank	NA	W	
12-06-88	120688-03	Station - 3	S-SW	
	-05	- 5	changing to	<0
	-06	- 6	W-SW	
12-07-88	120788-02	Station - 2	NW	
	-04	- 6		
	-05	- 5		<0
	120788 Blank	NA		
12-08-88	120888-02	Station - 2	NW	<0
	-04	- 4	changing to	<0
	-05	- 5	W-NW	<0
12-09-88	120988-02	Station - 2	W-SW	
	-04	- 4	changing to	<0
	-05	- 5	W	<0
12-10-88	121088-02	Station - 2	W-NW	
	-04	- 4		<0
	-05	- 5		
12-12-88	121288-01	Station - 1	S-SW	<0
	-04	- 4		
	-06	- 6		<0
	121288 Blank	NA		
12-13-88	121388-03	Station - 3	W	
	-05	- 5		
	-06	- 6		<0
12-14-88	121488-03	Station - 3	W-NW	<0
	-05	- 5		Void (P proble
	-06	- 6		<0
	121488 Blank	NA		

Table 3A
(continued)

Sampling Date	Sample Number	Sample Station Location	Wind Direction	PCM Results (Fiber/cc)
12-15-88	121588-03	Station - 3	N-NW	Void (Cowl fell off)
	-05	- 5		"
	-06	- 6		"
12-16-88	121688-03	Station - 3	W-NW	<0.01
	-05	- 5		<0.01
	-06	- 6		<0.01
12-17-88	121788-03	- 3	NW	ND
	-05	- 5		ND
	-06	- 6		<0.01
12-19-88	121988-01	Station - 1	S	ND
	-02	- 2		Void (generator fuel line problem)
	-04	- 4		<0.01
	-Blank	- 2		ND
12-20-88	122088-01	Station - 1	SSW	ND
	-02	- 2	Changing to	ND
	-04	- 4	W, WSW	<0.01
12-21-88	122188-02	Station - 2	N, NW	Void (Cowl fell off)
	-04	- 4		ND
	-05	- 5		ND
	-Blank	- 4		ND
12-22-88	122188-02	Station - 1	S, SE changing	<0.01
	-02	- 2	to	<0.01
	-05	- 5	S, SW	<0.01
01-03-89	010389-01	Station - 1	W, SW	0.01
	-04	- 4	changing	<0.01
	-06	- 6	to	ND
	-Blank	- 1	W, WNW	ND
01-04-89	010489-01	Station - 1	S, SW	<0.01
	-04	- 4		<0.01
	-06	- 6		ND

Table 3A
(continued)

Sampling Date	Sample Number	Sample Station Location	Wind Direction	PCM Re (Fibe
01-05-89	010589-01	Station - 1		(Cas fell a
	-04	- 4		
	-06	- 6		
	-Blank	- 4		
01-06-89	010689-01	Station - 1	NE	
	-03	- 3		
	-04	- 4		
01-07-89	010789-01	Station - 1	S-SW	(F was
	-03	- 3		
	-04	- 4		
11-28-88 to 11-29-88	112888-02	Station - 02	W-NW	
12-05-88 to 12-06-88	120588-05	Station - 05	NW changing to SW	
12-12-88 to 12-13-88	121288-06	Station - 06	S-SW changing to W-NW	
12-22-88 to 12-23-88	122288-01	Station - 01	S-SE changing to W-SW	
01-06-88 to 01-07-88	010688-04	Station - 04	NE changing to S	

NA - Not Applicable
ND - Not Detected

Table 4A

PCM Results for Remedial Construction Ambient Air Monitoring for Asbestos

January 10 through 13, 1989

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
01-10-89	011089-03	Station - 3	W - NW	<0.01
	011089-04	- 4		Void
	011089-06	- 6		ND
	Blank	- 3		NA
01-11-89	011189-02	Station - 2	S - SE	<0.01
	011189-04	- 4		ND
	011189-06	- 6		<0.01
01-12-89	011289-03	Station - 3	W - SW	ND
	011289-04	- 4		<0.01
	011289-06	- 6		ND
	Blank	- 3		ND
01-13-89	011389-03*	Station - 3		(Improper filter position)
	011389-04	- 4		ND
	011389-06	- 6		<0.01

Note: No remedial construction took place on 1-09-89; hence no samples were collected.

Table 5A

PCM Results for Remedial Construction
Ambient Air Monitoring for Asbestos

February 17 through March 17, 1989

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Res (Fibers
02-17-89	021789-02	Station - 2	N	ND
	021789-03	- 3		<0.01
	021789-04	- 4		<0.01
	Blank	- 2		ND
02-20-89	022089-02	Station - 2	N - NE	ND
	022089-03	- 3		ND
	022089-04	- 4		ND
02-21-89	022189-03	Station - 3	W - NW	ND
	022189-04	- 4		ND
	022189-05	- 5		VOID - Filter blown out
	Blank	- 5		ND
02-27-89	022789-03	Station - 3	W - NW	< [illegible]
	022789-05	- 5		< [illegible]
	022789-06	- 6		ND
02-28-89	022889-03	Station - 3	S - SW	<0.01
	022889-05	- 5		<0.01
	022889-06	- 6		<0.01
03-01-89	030189-03	Station - 3	W	<0.01
	030189-05	- 5		<0.01
	030189-06	- 6		ND
	Blank	- 5		ND
03-02-89	030289-02	Station - 2	N	ND
	030289-04	- 4		ND
	030289-05	- 5		ND
	Blank	- 5		ND
03-03-89	030389-02	Station - 2	SE	ND
	030389-04	- 4		ND
	030389-05	- 5		VOID (Cowl fell off)
03-04-89	030489-02	Station - 2	SW	ND
	030489-04	- 4		ND
	030489-05	- 5		ND

Table 5A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
03-06-89	030689-03	Station - 3	NE	ND
	030689-04	- 4		<0.01
	030689-06	- 6		ND
	Blank	- 5		ND
03-07-89	030789-03	Station - 3	E-NE	VOID (broken filter)
	030789-04	- 4		ND
	030789-06	- 6		ND
	Blank	- 4		ND
03-08-89	030889-03	Station - 3	E-SE	ND
	030889-04	- 4		<0.01
	030889-06	- 6		<0.01
03-09-89	030989-02	Station - 2	SE	ND
	030989-03	- 3		ND
	030989-05	- 5		<0.01
03-10-89	031089-02	Station - 2	SE	ND
	031089-03	- 3		<0.01
	031089-05	- 5		<0.01
03-11-89	031189-01	Station - 1	NW	ND
	031189-04	- 4		ND
	031189-06	- 6		ND
03-13-89	031389-01	Station - 1	S-SW	ND
	031389-04	- 4		ND
	031389-06	- 6		ND
	Blank	- 1		ND
03-14-89	031489-03	Station - 3	N - NE	ND
	031489-04	- 4		<0.01
	031489-06	- 6		<0.01
03-15-89	031589-02	Station - 2	N	ND
	031589-03	- 3	Changing to	ND
	031589-04	- 4	W	<0.01
03-16-89	031689-01	Station - 1	S - SW	<0.01
	031689-0	- 2		ND
	031689-04	- 4		<0.01
03-17-89	031789-01	Station - 1	E - NE	ND
	031789-03	- 3		ND
	031789-04	- 4		ND
	Blank	- 3		ND

Table 5A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Re (Fiber
03-20-89	032089-01	Station - 1	N-NE	N
	032089-03	- 3		N
	032089-04	- 4		N
	Blank	- 1		N
03-21-89	032189-01	Station - 1	N-NW	N
	032189-03	- 3	changing to	N
	032189-04	- 4	N-NE	<0.C
03-22-89	032289-01	Station - 1	E-S	N
	032289-03	- 3	(variable)	N
	032289-04	- 4		N
03-23-89	032389-01	Station - 1	S-SE	N
	032389-03	- 3		<0.C
	032389-04	- 4		<0.C
03-24-89	032489-03	Station - 3	S-SE	N
	032489-04	- 4		N
	032489-06	- 6		[illegible]
	Blank	- 4		N
03-25-89	032589-03	Station - 3	W-NW	<0.0
	032589-04	- 4	changing to	VOI (damage filter
	032589-06	- 6	N-NW	N

ND = Not Detected

Table 5B

PCM Results for Manville Trailer Air Monitoring for Asbestos

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
03-16-89*	031689-TRL	Inside Manville Trailer	<0.01
03-20-89	032089-TRL	"	<0.01
03-21-89	032189-TRL	"	<0.01
03-22-89	032289-TRL	"	<0.01
03-23-89	032389-TRL	"	<0.01
03-24-89	032489-TRL	"	<0.01
03-25-89	032589-TRL	"	<0.01
03-27-89	032789-TRL	"	<0.01
03-28-89	032889-TRL	"	<0.01

All samples were analyzed by Lake County Grading Company.

* Sample was analyzed by EMS Laboratories.

Table 5C

TEM Results of Remedial Construction Ambient Air Sampling for Asbestos

January, 1989

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results (Fibers>5 um/cc
01-10-89 to 01-11-89	011089-03	Station - 3	W - NW	ND

Table 6A

PCM Results for Remedial Construction Ambient Air Monitoring for Asbestos

March 27 through April 22, 1989

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
03-27-89	032789-03	Station - 3	W-SW	ND
	032789-05	- 5		ND
	032789-06	- 6		ND
03-28-89	032889-03	Station - 3	SE	ND
	032889-05	- 5		ND
	032889-06	- 6		ND
03-29-89	032989-03	Station - 3	E-NE	ND
	032989-04	- 4		ND
	032989-06	- 6		ND
	Blank	- 4		ND
03-30-89	033089-03	Station - 3	E-NE	ND
	033089-04	- 4		ND
	033089-06	- 6		ND
03-31-89	033189-02	Station - 2	NW	<0.01
	033189-04	- 4		<0.01
	033189-05	- 5		<0.01
04-01-89	040189-01	Station - 1	S	ND
	040189-02	- 2		ND
	040189-03	- 3		<0.01
04-03-89	040389-02	Station - 2	S	ND
	040389-04	- 4		ND
	040389-06	- 6		ND
	Blank	- 4		ND
04-04-89	040489-02	Station - 2	S	ND
	040489-04	- 4	changing	<0.01
	040489-06	- 6	to W	ND
04-05-89	040589-03	Station - 3	W	ND
	040589-04	- 4		ND
	040589-06	- 6		ND
04-06-89	040689-02	Station - 2	N	ND
	040689-03	- 3		ND
	040689-04	- 4		ND

Table 6A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Res (Fibers
04-07-89	040789-02	Station - 2	N-NE	N
	040789-03	- 3		N
	040789-04	- 4		N
	Blank	- 3		N
04-08-89	040889-02	Station - 2	N-NE	N
	040889-03	- 3		<0.0
	040889-04	- 4		N
04-10-89	041089-03	Station - 3	W	<0.0
	041089-05	- 5		<0.0
	041089-06	- 6		<0.0
	Blank	- 5		N
04-11-89	041189-03	Station - 3	W-SW	<0.0
	041189-04	- 4		<0.0
	041189-06	- 6		<0.0
04-12-89	041289-02	Station - 2	W-NW	N
	041289-04	- 4		N
	041289-06	- 6		0
04-13-89	041389-02	Station - 2	W-NW	N
	041389-04	- 4		N
	041389-06	- 6		<0.0
04-14-89	041489-02	Station - 2	S-SW	<0.0
	041489-04	- 4		N
	041489-06	- 6		<0.0
	Blank	- 4		N
04-15-89	041589-02	Station - 2	Calm to NE	N
	041589-04	- 4		N
	041589-04	- 6		N
04-17-89	041789-02	Station - 2	N-NE	N
	041789-04	- 4		Voi (cassett fell apart
	041789-05	- 5		N
	Blank	- 4		N
04-18-89	041889-02	Station - 2	Calm to E-NE	<0.0
	041889-04	- 4		<0.0
	041889-05	- 5		<0.0

Table 6A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
04-19-89	041989-02	Station - 2	N-NW	ND
	041989-04	- 4		<0.01
	041989-06	- 6		ND
04-20-89	042089-02	Station - 2	W-SW	<0.01
	042089-04	- 4	changing to	ND
	042089-06	- 6	E-SE	ND
04-21-89	042189-02	Station - 2	E-NE	<0.01
	042189-04	- 4		<0.01
	042189-06	- 6		ND
	Blank	- 4		ND
04-22-89*	042289-03	Station - 3	E-SE	<0.01
	042289-06	- 6		<0.01

* Only two samples were collected on 4-22-89 due to pump problems.

Table 6B

PCM Results for Manville Trailer Air Monitoring for Asbestos

Sampling Date	Sample Number	Sampling Station Location	PCM Re (Fiber
03-29-89	032989-TRL	Inside Manville Trailer	<0
03-30-89	033089-TRL	"	<0
03-31-89	033189-TRL	"	<0
04-01-89	040189-TRL	"	<0
04-03-89	040389-TRL	"	<0
04-04-89	040489-TRL	"	<0
04-05-89	040589-TRL	"	<0
04-06-89	040689-TRL	"	<0
04-07-89	040789-TRL	"	<0
04-08-89	040889-TRL	"	<0
04-10-89	041089-TRL	"	<0
04-11-89	041189-TRL	"	<0
04-12-89	041289-TRL	"	<0
04-13-89	041389-TRL	"	[illegible]
04-14-89	041489-TRL	"	[illegible]
04-15-89	041589-TRL	"	<0
04-17-89	041789-TRL	"	<0
04-18-89	041889-TRL	"	<0
04-19-89	041989-TRL	"	<0
04-20-89	042089-TRL	"	<0
04-21-89	042189-TRL*	"	<0
04-22-89	042289-TRL	"	<0
04-23-89	042389-TRL	"	<0
04-24-89	042489-TRL	"	<0
04-25-89	042589-TRL	"	<0
04-26-89	042689-TRL	"	<0

All Samples were analyzed by Mr. Fred Vincaguerra of Lake County Gr Company, unless otherwise noted.

*Sample analyzed by EMS Laboratories.

Table 7A

PCM Results for Remedial Construction Ambient Air Monitoring for Asbestos

April 24 through May 20, 1989

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
04-24-89*	042489-03	Station - 3	E-SE	<0.01
	Blank	- 5		ND
04-25-89	042589-03	Station - 3	N-NE	<0.01
	042589-04	- 4		ND
	042589-06	- 6		ND
04-26-89	042689-03	Station - 3	N-NE	<0.01
	042689-04	- 4		ND
	042689-06	- 6		ND
	Blank	- 3		ND
04-27-89	042789-03	Station - 3	N-NE	<0.01
	042789-04	- 4		<0.01
	042789-06	- 6		ND
04-28-89	> 0.1 inch of precipitation, no samples collected.			
04-29-89	042989-03	Station - 3	NE	VOID
	042989-04	- 4		<0.01
	042989-06	- 6		<0.01
05-01-89	050189-03	Station - 3	NE	<0.01
	050189-04	- 4		<0.01
	050189-06	- 6		<0.01
	Blank	- 6		ND
05-02-89	050289-02	Station - 2	Variable all day	<0.01
	050289-04	- 4		<0.01
	050289-05	- 5		ND
05-03-89	050389-02	Station - 2	NW to SW	ND
	050389-04	- 4		ND
	050389-05	- 5		ND
05-04-89	050489-02	Station - 2	S - SE	<0.01
	050489-04	- 4		<0.01
	050489-06	- 6		ND
	Blank	- 4		ND
05-05-89	050589-03	Station - 3	W - NW	<0.01
	050589-05	- 5		<0.01
	050589-06	- 6		<0.01

Table 7A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Re (Fiber
05-06-89	050689-03	Station - 3	W-NW	<0.
	050689-05	- 5	changing to	
	050689-06	- 6	E-NE	<0.
05-08-89	050889-03	Station - 3	W-NW	<0.
	050889-05	- 5	changing to	
	050889-06	- 6	E-SE	<0.
	Blank	- 6		
05-09-89	050989-03	Station - 3	N-NE	<0.
	050989-04	- 4		<0.
	050989-06	- 6		<0.
05-10-89	051089-03	Station - 3	NE	<0.
	051089-04	- 4		<0.
	051089-06	- 6		<0.
05-11-89	051189-03	Station - 3	N-NE	<0.
	051189-04	- 4		<0.
	051189-06	- 6		
	Blank	- 4		
05-12-89	051289-03	Station - 3	NE	<0.
	051289-04	- 4		<0.
	051289-06	- 6		<0.
05-13-89	051389-03	Station - 3	NE	<0.
	051389-04	- 4		<0.
	051389-06	- 6		
05-15-89	051589-03	Station - 3	W-NW	<0.
	051589-05	- 5		<0.
	051589-06	- 6		
05-16-89	051689-03	Station - 3	E-NE	<0.
	051689-05	- 5		<0.
	051689-06	- 6		<0.
	Blank	- 3		
05-17-89	051789-03	Station - 3	NE	<0.
	051789-04	- 4		<0.
	051789-06	- 6		
05-18-89	051889-02	Station - 2	E-SE	
	051889-03	- 3		<0.
	051889-04	- 4		

Table 7A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
05-19-89	051989-02	Station - 2	S-SE	All PCM Samples Void- Cassettes came apart in rain.
	051989-03	- 3		
	051989-04	- 4		
	Blank	- 3		ND
05-20-89	052089-02	Station - 2	N-NW	<0.01
	052089-03	- 3		<0.01
	052089-04	- 4		<0.01

*Only one PCM Sample was collected due to generator failure.

Table 7B

PCM Results for Manville Trailer Air Monitoring for Asbestos

April 27 through May 20, 1989

Sampling Date	Sample Number	Sampling Station Location	PCM Res (Fibers
04-27-89	042789-TRL	Inside Manville Trailer	<0.0
04-28-89	042889-TRL	"	<0.0
04-29-89	042989-TRL	"	<0.0
05-01-89	050189-TRL	"	<0.0
05-02-89	050289-TRL	"	<0.0
05-03-89	050389-TRL	"	0.0
05-04-89	050489-TRL	"	<0.0
05-05-89	050589-TRL	"	<0.0
05-06-89	050689-TRL	"	<0.0
05-08-89	050889-TRL	"	0.0
05-09-89	050989-TRL	"	<0.0
05-10-89	051089-TRL	"	<0.0
05-11-89	051189-TRL	"	<0.0
05-12-89	051289-TRL	"	[illegible]
05-13-89	051389-TRL	"	[illegible]
05-14-89	051489-TRL	"	0.0
05-15-89	051589-TRL	"	0.0
05-16-89	051689-TRL	"	<0.0
05-17-89	051789-TRL	"	<0.0
05-18-89	051889-TRL	"	<0.0
05-19-89	051989-TRL	"	<0.0
05-20-89	052089-TRL	"	<0.0

Table 7C

TEM Results for Remedial Construction
Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results (Fibers >5um/cc)
02-17-89 to 02-18-89	021789-03	Station - 3	N	ND
03-01-89 to 03-02-89	030189-03	Station - 3	W	ND
03-06-89 to 03-07-89	030689-03	Station - 3	NE	ND
03-14-89 to 03-15-89	031489-04	Station - 4	N-NE	ND
03-23-89 to 03-24-89	032389-03	Station - 3	S-SE	ND
04-04-89 to 04-05-89	040489-04	Station - 4	S changing to W	ND
04-11-89 to 04-12-89	041189-04	Station - 4	W-SW	<0.01
04-21-89 to 04-22-89	042189-06	Station - 6	E-NE	ND

Table 8A

PCM Results of Remedial Construction
Ambient Air Monitoring for Asbestos

May 22 through June 17, 1989

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM R (Fibe
05-22-89	052289-02	Station - 2	W-NW	N
	052289-04	- 4		<0.0
	052289-05	- 5		<0.0
	Blank	- 5		N
05-23-89	052389-02	Station - 2	W-SW	<0.0
	052389-04	- 4		<0.0
	052389-05	- 5		<0.0
05-24-89	052489-03	Station - 3	SE	<0.0
	052489-05	- 5		<0.0
	052489-06	- 6		<0.0
05-25-89	052589-03	Station - 3	W to SE changing to NE	N
	052589-05	- 5		N
	052589-06	- 6		
	Blank	- 3		N
05-25-89	052689-03	Station - 3	S to W	<0.0
	052689-05	- 5		
	052689-06	- 6		<0.0
05-30-89	053089-04	Station - 4	S to E	<0.0
	053089-06	- 6		<0.0
	Blank	- 4		N
05-31-89	053189-03	Station - 3	SE changing to S-SW	<0.0
	053189-05	- 5		<0.0
06-01-89	060189-03	Station - 3	Calm to NE	<0.0
	060189-05	- 5		<0.0
	060189-06	- 6		<0.0
06-02-89	060289-03	Station - 3	S-SE changing to SW	<0.0
	060289-05	- 5		<0.0
	060289-06	- 6		<0.0
	Blank	- 3		N

Table 8A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
06-05-89	060589-03	Station - 3	E - SE	<0.01
	060589-05	- 5		ND
	060589-06	- 6		<0.01
	Blank	- 3		ND
06-06-89	060689-03	Station - 3	SE to SW	<0.01
	060689-05	- 5		<0.01
	060689-06	- 6		<0.01
06-07-89	060789-03	Station - 3	W to SW	<0.01
	060789-05	- 5		<0.01
	060789-06	- 6		Cassette fell apart
	Blank	- 5		ND
06-08-89	060889-03	Station - 3	SE	<0.01
	060889-05	- 5		ND
	060889-06	- 6		<0.01
06-09-89	060989-03	Station - 3	NW	<0.01
	060989-05	- 5		<0.01
	060989-06	- 6		<0.01
	Blank	- 5		ND
06-10-89	061089-03	Station - 3	W changing to N	ND
	061089-05	- 5		ND
	061089-06	- 6		ND
06-12-89	No samples collected due to rain.			
06-13-89	No samples collected due to rain.			
06-14-89	061489-03	Station - 3	N-NE	ND
	061489-04	- 4		<0.01
	061489-06	- 6		ND
	Blank	- 4		ND
06-15-89	061589-03	Station - 3	NE changing to N-NE	<0.01
	061589-04	- 4		Void-Filter Blown Out
	061589-06	- 6		<0.01

Table 1
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM R (Fibe
06-16-89	No samples collected due to rain.			
06-17-89	061789-03	Station - 3	W changing to N	<0.0
	061789-05	- 5		<0.0
	061789-06	- 6		N

* Debris covered > 50% of Filter, unable to count.

Table 8B

PCM Results of Manville Trailer Air Monitoring for Asbestos

May 23 through June 22, 1989

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
05-23-89	052389-TRL	Inside Manville Trailer	<0.01
05-24-89	052489-TRL	"	<0.01
05-25-89	052589-TRL	"	<0.01
05-25-89	052689-TRL	"	<0.01
05-30-89	053089-TRL	"	<0.01
05-31-89	053189-TRL	"	<0.01
06-01-89	060189-TRL	"	<0.01
06-02-89	060289-TRL	"	<0.01
06-03-89	060389-TRL	"	<0.01
06-05-89	060589-TRL	"	<0.01
06-06-89	060689-TRL	"	<0.01
06-07-89	060789-TRL	"	<0.01
06-08-89	060889-TRL	"	<0.01
06-09-89	060989-TRL	"	<0.01
06-10-89	061089-TRL	"	<0.01
06-12-89	061289-TRL	"	<0.01
06-13-89	061389-TRL	"	<0.01
06-14-89	061489-TRL	"	Loaded with debris, unable to count
06-15-89	061589-TRL	"	<0.01
06-16-89	061689-TRL	"	<0.01
06-17-89	061789-TRL	"	<0.01
06-19-89	061989-TRL	"	<0.01
06-20-89	062089-TRL	"	<0.01
06-21-89	062189-TRL	"	<0.01
06-22-89	062289-TRL	"	<0.01

Table 8C

TEM Results of Remedial Construction
Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM F (Fibers>5
05-09-89 to 05-10-89	050989-03	Station - 3	N - NE	<0.(
05-17-89 to 05-18-89	051789-03	Station - 3	NE	<0.(
05-24-89 to 05-25-89	052489-05	Station - 5	SE	<0.
05-30-89 to 05-31-89	053089-04	Station - 4	S to E	

Table 9A

PCM Results of Remedial Construction Ambient Air Monitoring for Asbestos

June 19 through July 18, 1989

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
06-19-89	061989-03	Station - 3	N-NE	VOID-Generator Failure
	061989-04	- 4		ND
	061989-06	- 6		<0.01
	061989-BLK	- 3		ND
06-20-89	062089-03	Station - 3	N-NE	<0.01
	062089-04	- 4		<0.01
	062089-06	- 6		ND
06-21-89	062189-03	Station - 3	NE	<0.01
	062189-04	- 4		VOID-Generator Failure
	062189-06	- 6		ND
06-22-89	062289-03	Station - 3	Calm to S-SE	<0.01
	062289-04	- 4		<0.01
	062289-06	- 6		ND
	062289-BLK	- 4		ND
06-23-89	062389-03	Station - 3	SE changing to	<0.01
	062389-05	- 5	SW	<0.01
	062389-06	- 6		<0.01
06-24-89	062489-03	Station - 3	SW	<0.01
	062489-05	- 5	changing to	ND
	062489-06	- 6	NE	<0.01
06-26-89	062689-02	Station - 2	Calm to SE	VOID-rain
	062689-03	- 3		VOID-rain
	062689-05	- 5		VOID-rain
	062689-BL	- 3		ND
06-27-89	062789-02	Station - 2	N-NE	ND
	062789-03	- 3	changing	<0.01
	062789-05	- 5	to E-SE	VOID-Generator Failure

Table 9A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Resu (Fibers/
06-28-89	062889-02	Station - 2	NE	N
	062889-03	- 3		<0.0
	062889-05	- 4		
06-29-89	062989-02	Station - 2	E-NE	N
	062989-03	- 3		<0.0
	062989-05	- 5		<0.0
06-30-89	063089-02	Station - 2	SW	<0.0
	063089-03	- 3	changing to	<0.0
	063089-06	- 6	E	<0.0
07-05-89	070589-02	Station - 2	N-NE	<0.0
	070589-03	- 3		<0.0
	070589-04	- 4		<0.0
	070589-BLK	- 4		N
07-06-89	070689-02	Station - 2	Calm to S	<0.0
	070689-03	- 3		<0.0
	070689-04	- 4		<0.0
07-07-89	070789-02	Station - 2	NW	[illegible]
	070789-03	- 3	changing to	<0.0
	070789-04	- 4	NE	<0.0
07-10-89	071089-02	Station - 2	NW	<0.0
	071089-03	- 3	changing to	<0.0
	071089-05	- 5	NE	<0.0
07-11-89	071189-03	Station - 3	NE	<0.0
	071189-04	- 4		<0.0
	071189-06	- 6		<0.0
	071189-BLK	- 4		N
07-12-89	071289-02	Station - 2	N-NW	<0.0
	071289-03	- 3	changing to	<0.0
	071289-05	- 5	N-NE	<0.0
07-13-89	071389-02	Station - 2	N-NW	N
	071389-03	- 3	changing to	<0.0
	071389-05	- 5		<0.0
07-14-89	071489-02	Station - 2	NW	<0.0
	071489-03	- 3	changing to	<0.0
	071489-05	- 5	N	<0.0
	071589-BLK	- 5		N

Table 9A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
07-15-89	071589-02	Station - 2	Calm to	<0.01
	071589-03	- 3	SE	<0.01
	071589-06	- 6		ND
07-17-89	071789-03	Station - 3	S	<0.01
	071789-05	- 5	changing to	<0.01
	071789-06	- 6	E-SE	<0.01
	071789-BLK	- 5		ND
07-18-89	071889-02	Station - 2	SE	ND
	071889-03	- 3	changing to	<0.01
	071889-06	- 6	E	<0.01
07-19-89	No sampling due to rain.			
07-20-89	No sampling due to rain.			
07-21-89	No sampling due to rain.			
07-22-89	No on-site work--no sampling.			
07-24-89	072489-03	Station - 3	Calm to NE	ND
	072489-04	- 4		<0.01
	072489-06	- 6		ND
	072489-BLK	- 6		ND
07-25-89	072589-03	Station - 3	Calm	ND
	072589-04	- 4		ND
	072589-06	- 6		ND

ND = Not Detected

* = Unable to analyze debris covered greater than 50% of the filter.

Table 9B

PCM Results of Manville Trailer Air Monitoring for Asbestos

June 23 through July 11, 1989

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
06-19-89	061989-TRL	Inside Manville Trailer	<0.01
06-20-89	062089-TRL	"	<0.01
06-21-89	062189-TRL	"	<0.01
06-22-89	062289-TRL	"	<0.01
06-23-89	062389-TRL	"	<0.01
06-24-89	062489-TRL	"	<0.01
06-26-89	062689-TRL	"	<0.01
06-27-89	062789-TRL	"	<0.01
06-28-89	062889-TRL	"	<0.01
06-29-89	062989-TRL	"	<0.01
06-30-89	063089-TRL	"	<0.01
07-05-89	070589-TRL	"	<0.01
07-06-89	070689-TRL	"	<0.01
07-07-89	070789-TRL	"	<0.01
07-08-89	070889-TRL	"	<0.01
07-10-89	071089-TRL	"	<0.01
07-11-89	071189-TRL	"	<0.01

Table 9C

TEM Results of Remedial Construction
Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results (Fibers>5 um/cc)
05-05-89 to 05-06-89	050589-06	Station - 3	W - NW	0.02
06-09-89 to 06-10-89	060989-05	Station - 5	NW	ND
06-14-89 to 06-15-89	061489-04	Station - 4	N - NE	ND

ND = Not Detected

Table 10A

PCM Results of Remedial Construction Ambient Air Monitoring for Asbestos

July 24 through August 22, 1989

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Result (Fibers/cc
07-24-89	072489-03	Station - 3	Calm to NE	ND
	072489-04	- 4	NE	<0.01
	072489-06	- 6		ND
	072489-BLK	- 6		ND
07-25-89	072589-03	Station - 3	Calm	ND
	072589-04	- 4		ND
	072589-06	- 6		ND
07-26-89	072689-03	Station - 3	SW	<0.01
	072689-05	- 5	changing to	ND
	072689-06	- 6	SE	ND
07-27-89	072789-03	Station - 3	SW	<0.01
	072789-05	- 5		<0.01
	072789-06	- 6		<0 [illegible]
	072789-BLK	- 3		
07-28-89	072889-03	Station - 3	NW	ND
	072889-04	- 4		ND
	072889-06	- 6		ND
07-29-89	072989-03	Station - 3	Calm to SE	ND
	072989-04	- 4		<0.01
	072989-06	- 6		ND
07-31-89	073189-03	Station - 3	NE to E-NE	ND
	073189-04	- 4		ND
	073189-06	- 6		ND
	073189-BLK	- 6		ND
08-01-89	080189-03	Station - 3	Calm	ND
	080189-04	- 4		Void-Generator Failure
	080189-06	- 6		Void-Generator Failure
08-02-89	080289-03	Station - 3	SW	<0.01
	080289-05	- 5	changing to	<0.01
	080289-06	- 6	W	

Table 10A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
08-03-89	080389-03	Station - 3	SE to SW	<0.01
	080389-05	- 5	changing to	<0.01
	080389-06	- 6	S to W	<0.01
08-04-89	080489-03	Station - 3	W	<0.01
	080489-06	- 6		ND
	080489-BLK	- 6		ND
08-07-89	080789-03	Station - 3	W-SW	ND
	080789-05	- 5	changing to E	Void-Generator Failure
	080789-06	- 6		ND
	080789-BLK	- 3		ND
08-08-89	080889-03	Station - 3	SW	<0.01
	080889-05	- 5		*
	080889-06	- 6		<0.01
08-09-90	080989-03	Station - 3	SW	<0.01
	080989-05	- 5	changing to	<0.01
	080989-05	- 6	E	<0.01
	080989-BLK	- 3		ND
08-10-89	081089-03	Station - 3	S-SW	0.01
	081089-05	- 5	changing to	<0.01
	081089-06	- 6	E	<0.01
08-11-89	081189-03	Station - 3	SW	<0.01
	081189-05	- 5	changing to	<0.01
	081189-06	- 6	SE	ND
08-12-89	081289-03	Station - 3	SW	<0.01
	081289-05	- 5	changing to	<0.01
	081289-06	- 6	SE	ND
08-14-89	081489-03	Station - 3	S	<0.01
	081489-05	- 5	changing to	<0.01
	081489-06	- 6	W	ND
	081489-BLK	- 3		ND
08-15-89	081589-03	Station - 3	W-SW	ND
	081589-05	- 5	changing to	ND
	081589-06	- 6	N-NW	<0.01
08-16-89	081689-03	Station - 3	W-SW	<0.01
	081689-05	- 5	changing to	ND
	081689-06	- 6	E-SE	ND
	081689-BLK	- 6		ND

Table 10A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Result (Fibers/cc
08-17-89	081789-03	Station - 3	W	<0.01
	081789-05	- 5	changing to	ND
	081789-06	- 6	NE	ND
08-18-89	081889-03	Station - 3	Calm	<0.01
	081889-05	- 5	to	<0.01
	081889-06	- 6	NE-E	<0.01
08-19-89	081989-03	Station - 3	Calm	<0.01
	081989-05	- 5	to	ND
	081989-06	- 6	E	ND
08-21-89	082189-03	Station - 3	Calm	<0.01
	082189-05	- 5	to	ND
	082189-06	- 6	SE	ND
	082189-BLK	- 3		ND
08-22-89	082289-03	Station - 3	S-SW	<0.01
	082289-05	- 5		<0.01
	082289-06	- 6		0.01

ND = Not Detected
* Unable to count, debris covered greater than 50% of the filter.

Table 10B

PCM Results of Manville Trailer Air Monitoring for Asbestos

July 12 through August 22, 1989

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
07-12-89	071289-TRL	Inside Manville Trailer	<0.01
07-13-89	071389-TRL	Inside Manville Trailer	<0.01
07-14-89	071489-TRL	Inside Manville Trailer	<0.01
07-15-89	071589-TRL	Inside Manville Trailer	<0.01
07-17-89	071789-TRL	Inside Manville Trailer	<0.01
07-18-89	071889-TRL	Inside Manville Trailer	<0.01
07-19-89	071989-TRL	Inside Manville Trailer	<0.01
07-20-89	072089-TRL	Inside Manville Trailer	<0.01
07-21-89	072189-TRL	Inside Manville Trailer	<0.01
07-22-89	072289-TRL	Inside Manville Trailer	<0.01
07-24-89	072489-TRL	Inside Manville Trailer	<0.01
07-25-89	072589-TRL	Inside Manville Trailer	<0.01
07-26-89	072689-TRL	Inside Manville Trailer	ND
07-27-89	072789-TRL	Inside Manville Trailer	<0.01
07-28-89	072889-TRL	Inside Manville Trailer	<0.01
07-29-89	072989-TRL	Inside Manville Trailer	<0.01
07-31-89	073189-TRL	Inside Manville Trailer	<0.01
08-01-89	080189-TRL	Inside Manville Trailer	<0.01
08-02-89	080289-TRL	Inside Manville Trailer	ND
08-03-89	080389-TRL	Inside Manville Trailer	ND
08-04-89	080489-TRL	Inside Manville Trailer	<0.01
08-07-89	080789-TRL	Inside Manville Trailer	<0.01
08-08-89	080889-TRL	Inside Manville Trailer	<0.01
08-09-89	080989-TRL	Inside Manville Trailer	ND
08-10-89	081089-TRL	Inside Manville Trailer	<0.01
08-11-89	081189-TRL	Inside Manville Trailer	ND
08-12-89	081289-TRL	Inside Manville Trailer	<0.01
08-14-89	081489-TRL	Inside Manville Trailer	<0.01
08-15-89	081589-TRL	Inside Manville Trailer	ND
08-16-89	081689-TRL	Inside Manville Trailer	<0.01
08-17-89	081789-TRL	Inside Manville Trailer	ND
08-18-89	081889-TRL	Inside Manville Trailer	<0.01
08-19-89	081989-TRL	Inside Manville Trailer	ND
08-21-89	082189-TRL	Inside Manville Trailer	<0.01
08-22-89	082289-TRL	Inside Manville Trailer	ND

ND = Not Detected

Table 10C

TEM Results of Remedial Construction
Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Res (Fibers>5
04-27-89 to 04-28-89	042789-04	Station - 4	N-NE	<0.01
06-23-89 to 06-24-89	062389-05	Station - 5	SE changing to SW	ND
06-29-89 to 06-30-89	062989-03	Station - 3	E-NE	<0.01
07-05-89 to 07-06-89	070589-04	Station - 4	N-NE	<0.01
07-11-89 to 07-12-89	071189-04	Station - 4	NE	ND

ND = Not Detected

Table 10D

Summary of TEM Results of Ambient Air Monitoring for Asbestos Conducted During the Week Prior to Heavy Remedial Construction

May 1 through May 6, 1989

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results (Fibers>5um/cc)
05-01-89 to 05-02-89	050189-04	Station - 4	NE	<0.01
05-02-89 to 05-03-89	050289-04	Station - 4	Variable all day	ND
05-03-89 to 05-04-89	050389-04	Station - 4	NW to SW	ND
05-04-89 to 05-05-89	050489-04	Station - 4	S-SE	ND
05-04-89 to 05-05-89	050489-BLK	Station - 4	S-SE	ND
05-05-89 to 05-06-89	050589-03	Station - 3	W-NW changing to E-NE	ND

ND = Not Detected

Table 10E

Summary of TEM Results of Ambient Air Monitoring for Asbestos Conducted During the First Week of Heavy Remedial Construction

May 8 through 13, 1989

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Resul (Fibers>5 u
05-08-89 to 05-09-89	050889-03	Station - 3	W-NW changing to E-SE	0.01
05-09-89 to 05-10-89	050989-04	Station - 4	N-NE	<0.01
05-10-89 to 05-11-89	051089-04	Station - 4	NE	<0.01
05-11-89 05-12-89	051189-04	Station - 4	N-NE	0.01
05-11-89 to 05-12-89	051189-BLK	Station - 4	N-NE	ND
05-12-89 to 05-13-89	051289-03	Station - 3	NE	

ND = Not Detected

Table 11A

PCM Results of Remedial Construction Ambient Air Monitoring for Asbestos

(August 23 through September 23, 1989)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
08-23-89	082389-03	Station - 3	NE	<0.01
	082389-04	- 4		<0.01
	082389-06	- 6		<0.01
	082389-BLK	- 6		ND
08-24-89	082489-03	Station - 3	N-NE	<0.01
	082489-04	- 4		<0.01
	082489-06	- 6		ND
08-25-89	082589-03	Station - 3	NE	<0.01
	082589-04	- 4		<0.01
	082589-06	- 6		<0.01
08-26-89	082689-02	Station - 2	E-SE	ND
	082689-03	- 3		<0.01
	082689-04	- 4		<0.01
08-28-89	No perimeter air sampling due to rain.			
08-29-89	No perimeter air sampling due to wet conditions.			
08-30-89	083089-03	Station - 3	W to Calm	ND
	083089-05	- 5		<0.01
	083089-06	- 6		<0.01
	083089-BLK	- 3		ND
08-31-89	083189-03	Station - 3	SE to SW	<0.01
	083189-05	- 5		<0.01
	083189-06	- 6		<0.01
09-01-89	No perimeter air sampling due to rain.			
09-05-89	090589-03	Station - 3	Calm to E	<0.01
	090589-05	- 5		Void-Generator failure
	090589-06	- 6		Void-Generator failure
	090589-BLK	- 3		ND
09-06-89	No perimeter air sampling due to rain.			
09-07-89	090789-03	Station - 3	S to E	<0.01
	090789-05	- 5		ND
	090789-06	- 6		ND

Table 11A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM [illegible] (F[illegible]
09-08-89	090889-03	Station - 3	SW to Calm	<0.0
	090889-05	- 5		N
	090889-06	- 6		N
09-09-89	No perimeter air sampling due to rain.			
09-11-89	091189-03	Station - 3	Calm to N-NE	<0.0
	091189-05	- 5		N
	091189-06	- 6		<0.0
	091189-BLK	- 3		N
09-12-89	091289-02	Station - 2	W to NE	N
	091289-04	- 4		<0.0
	091289-05	- 5		<0.0
09-13-89	No perimeter air sampling due to rain.			
09-14-89	091489-03	Station - 3	N - NE	<0.0
	091489-04	- 4		N
	091489-06	- 6		<0.0
	091489-BLK	- 6		N
09-15-89	091589-03	Station - 3	Calm to N	<0.0
	091589-04	- 4		< [illegible]
	091589-06	- 6		[illegible]
09-16-89	091689-03	Station - 3	Calm to E	<0.0
	091689-04	- 4		N
	091689-06	- 6		<0.0
09-18-89	091889-03	Station - 3	SE changing to N to E	<0.0
	091889-04	- 4		[illegible]
	091889-06	- 6		N
	091889-BLK	- 6		N
09-19-89	091989-02	Station - 2	SE to E-NE	<0.0
	091989-03	Station - 3		<0.0
	091989-04	- 4		[illegible]
09-20-89	092089-03	Station - 3	SW to SE	<0.0
	092089-05	- 5		N
	092089-06	- 6		N
	092089-BLK	- 3		N
09-21-89	092189-03	Station - 3	SW to SE	<0.0
	092189-05	- 5		N
	092189-06	- 6		N

Table 11A
(continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
09-22-89	092289-03	Station - 3	W-SW	<0.01
	092289-05	- 5	to	<0.01
	092289-06	- 6	W-NW	<0.01
09-23-89	092389-03	Station - 3	W-NW to W	<0.01
	092389-05	- 5		<0.01
	092389-06	- 6		VOID-Generator failure

ND = Not Detected
* = Unable to count, debris coverd greater than 50% of the filter area.

Table 11B

PCM Results of Manville Trailer Air Monitoring for Asbestos

August 23 through September 22, 1989

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
08-23-89	082389-TRL	Inside Manville Trailer	<0.01
08-24-89	082489-TRL	"	ND
08-25-89	082589-TRL	"	<0.01
08-26-89	082689-TRL	"	<0.01
08-28-89	082889-TRL	"	<0.01
08-29-89	082989-TRL	"	<0.01
08-30-89	083089-TRL	"	<0.01
08-31-89	083189-TRL	"	<0.01
09-01-89	090189-TRL	"	<0.01
09-05-89	090589-TRL	"	<0.01
09-06-89	090689-TRL	"	<0.01
09-07-89	090789-TRL	"	<0.01
09-08-89	090889-TRL	"	<0.01
09-09-89	090989-TRL	"	<0.01
09-11-89	091189-TRL	"	<0.01
09-12-89	091289-TRL	"	<0.01
09-13-89	091389-TRL	"	<0.01
09-14-89	091489-TRL	"	<0.01
09-15-89	091589-TRL	"	<0.01
09-16-89	091689-TRL	"	<0.01
09-18-89	091889-TRL	"	<0.01
09-19-89	091989-TRL	"	<0.01
09-20-89	092089-TRL	"	<0.01
09-21-89	092189-TRL	"	<0.01
09-22-89	092289-TRL	"	<0.01

ND = Not Detected

Table 11C

TEM Results of Remedial Construction
Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results (Fibers>5 um/cc)
07-17-89 to 07-18-89	071789-03	Station - 3	S to E-SE	<0.01
07-24-89 to 07-25-89	072489-04	Station - 4	Calm to NE	ND
08-03-89 to 08-04-89	080389-03	Station - 3	SE to SW changing to S to W	<0.01
08-08-89 to 08-04-89	080889-06	Station - 6	SW	<0.01
08-15-89 to 08-16-89	081589-06	Station - 6	W-SW changing to N-NW	ND

ND= Not Detected

Table 12A

PCM Results of Remedial Construction Ambient Air Monitoring for Asbestos

September 25 through October 20, 1989

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Resul (Fibers/c
09-25-89	092589-03	Station - 3	S to SE	<0.01
	092589-05	- 5		<0.01
	092589-06	- 6		VOID - Generator Failure
	092589-BLK	- 3		ND
09-26-89	092689-02	Station - 2	W	<0.01
	092689-04	- 4		<0.01
	092689-05	- 5		<0.01
09-27-89	092789-02	Station - 2	E	<0.01
	092789-03	- 3		<0.01
	092789-05	- 5		<0.01
	092789-BLK	- 5		ND
09-28-89	092889-03	Station - 3	SE	<0.[illegible]
	092889-05A#	Station - 5	SE	<0.01
	092889-05B#	- 5	W to N	<0.01
	092889-06A#	- 6		ND
	092889-06B#	- 6		<0.01
09-29-89	092989-03	Station - 3	W to N	<0.01
09-30-89	093089-03	Station - 3	E to NE	<0.01
	093089-06	- 6		ND
10-02-89	100290-03	Station - 3	E to NE	<0.01
	100289-05	- 5		<0.01
	100289-06	- 6		<0.01
	100289-BLK	- 3		ND
10-03-89	100389-03	Station - 3	W-SW	<0.01
	100389-05	- 5		<0.01
	100389-06	- 6		ND
10-04-90	100489-03	Station - 3	W-SW to S	<0.01
	100489-05	- 5		ND
	100489-06	- 6		<0.01
	100489-BLK	- 3		ND

Table 12A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
10-05-89	100589-02	Station - 2	S-SW	<0.01
	100589-03	- 3		<0.01
	100589-06	- 6		Sample was wet-could not be analyzed
10-06-89	No perimeter sampling due to rain.			
10-07-89	100789-03	Station - 3	W-SW	ND
	100789-05	- 5		ND
	100789-06	- 6		<0.01
10-09-89	100989-03	Station - 3	SW-SE to E	ND
	100989-05	- 5		<0.01
	100989-06	- 6		<0.01
10-10-89	101089-03	Station - 3	SW	ND
	101089-05	- 5		<0.01
	101089-06	- 6		<0.01
	101089-BLK	- 3		ND
10-11-89	101189-02	Station - 2	SW	<0.01
	101189-03	- 3		<0.01
	101189-06	- 6		<0.01
10-12-89	101289-02	Station - 2	N to E	<0.01
	101289-04	- 4		<0.01
	101289-05	- 5		<0.01
10-13-89	101389-02	Station - 2	N to SE	<0.01
	101389-03	- 3		<0.01
	101389-05	- 5		<0.01
10-14-89	101489-03	Station - 3	SE	<0.01
	101489-05	- 5		<0.01
	101489-06	- 6		<0.01
	101489-BLK	- 3		ND
10-16-89	101689-02	Station - 2	W-NW	<0.01
	101689-03	- 3		<0.01
	101689-04	- 4		<0.01
	101689-BLK	- 3		ND
10-17-89	No perimeter sampling due to wet site conditions.			
10-18-89	101889-02	Station - 2	W	<0.01
	101889-03	- 3		VOID-Cassette fell apart
	101889-04	- 4		ND

Table 12A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM [illegible] (Fi[illegible]
10-19-89	101989-03	Station - 3	N-NW	ND
	101989-04	- 4		ND
	101989-06	- 6		ND
	101989-BLK	- 6		ND
10-20-89	No perimeter air sampling due to rain.			

ND = Not Detected

#Laboratory was unable to distinguish between 092889-05 and 092989-05 092889-06 and 092989-06. Samples were designated A and B and calculated the lowest volume for a worst case scenario.

Table 12B

PCM Results of Manville Trailer Air Monitoring for Asbestos

September 25 through October 20, 1989

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
09-25-89	092589-TRL	Inside Manville Trailer	<0.01
09-26-89	092689-TRL	"	<0.01
09-27-89	092789-TRL	"	<0.01
09-28-89	092889-TRL	"	<0.01
09-29-89	092989-TRL	"	<0.01
09-30-89	093089-TRL	"	<0.01
10-02-89	100289-TRL	"	<0.01
10-03-89	100389-TRL	"	<0.01
10-04-89	100489-TRL	"	<0.01
10-05-89	100589-TRL	"	<0.01
10-06-89	100689-TRL	"	<0.01
10-07-89	100789-TRL	"	<0.01
10-08-89	100889-TRL	"	<0.01
10-09-89	100989-TRL	"	<0.01
10-10-89	101089-TRL	"	<0.01
10-11-89	101189-TRL	"	<0.01
10-12-89	101289-TRL	"	<0.01
10-13-89	101389-TRL	"	<0.01
10-14-89	101489-TRL	"	<0.01
10-16-89	101689-TRL	"	<0.01
10-17-89	101789-TRL	"	<0.01
10-18-89	101889-TRL	"	<0.01
10-19-89	101989-TRL	"	<0.01
10-20-89	092089-TRL	"	ND

ND = Not Detected

Table 12C

TEM Results of Remedial Construction Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Res (Fibers>5 u
08-24-89 to 08-25-89	082489-04	Station - 4	N to NE	<0.
08-31-89 to 09-01-89	083189-06	Station - 6	SE to SW	<0.
09-07-89 to 09-08-89	090789-03	Station - 3	S to E	
09-12-89 09-13-89	091289-04	Station - 4	W to NE	
09-19-89 to 09-20-89	091989-02	Station - 2	SE to E-NE	

ND = Not Detected

Table 12D

TEM Results of Remedial Construction Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results (Fibers >5 um/cc)
06-09-89 to 06-10-89	060989-05D	5	NW	ND
08-08-89 to 08-09-89	080889-06R	6	SW	ND
07-05-89 to 07-06-89	070589-BLK	4	N to NE	ND

ND = Not Detected

Table 13A

PCM Results of Remedial Construction Ambient Air Monitoring for Asbestos

October 23 through November 17, 1989

Date	Sample Number	Sampling Station Location	Wind Direction	Sampli PCM Resu (Fibers/
10-23-89	102389-02	Station - 2	S	ND
	102389-03	- 3		<0.01
	102389-06	- 6		ND
	102389-BLK	- 3		ND
10-24-89	102489-02	Station - 2	E	<0.01
	102489-03	- 3		ND
	102489-06	- 6		<0.01
10-25-89	102589-02	Station - 2	SE	<0.01
	102589-03	- 3		<0.01
	102589-06	- 6		<0.01
10-26-89	102689-02	Station - 2	Calm to SE	ND
	102689-03	- 3		<0.01
	102689-06	- 6		Void- F
10-27-89	102789-02	Station - 2	S	ND
	102789-03	- 3		ND
	102789-06	- 6		Void- Gener Failu
	102789-BLK	- 3		ND
10-28-89	102889-02	Station - 2	S-SE	<0.01
	102889-03	- 3		<0.01
	102889-06	- 6		Void- Gener Failu
10-30-89	103089-02	Station - 2	SE	<0.01
	103089-03	- 3		<0.01
	103089-06	- 6		<0.01
	103089-BLK	- 3		ND
10-31-89	103189-02	Station - 2	SE to SW	ND
	103189-03	- 3		<0.01
	103189-06	- 6		<0.01
11-01-89	110189-03	Station - 3	W to N-NW	<0.01
	110189-05	- 5		
	110189-06	- 6		

Table 13A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
11-02-89	110289-03	Station - 3	W-NW	<0.01
	110289-05	- 5		ND
	110289-06	- 6		ND
	110289-BLK	- 3		ND
11-03-89	110389-03	Station - 3	W	ND
	110389-05	- 5		Void--Generator Failure
	110389-06	- 6		<0.01
11-04-89	110489-02	Station - 2	S-SE	ND
	110489-03	- 3		ND
	110489-06	- 6		ND
11-06-89	110689-03	Station - 3	SW	<0.01
	110689-05	- 5		<0.01
	110689-06	- 6		ND
	110689-BLK	- 3		ND
11-07-89	No Perimeter Air Monitoring due to rain.			
11-08-89	No Perimeter Air Monitoring due to rain.			
11-09-89	110989-03	Station - 3	SE to SW	<0.01
	110989-05	- 5		<0.01
	110989-06	- 6		<0.01
11-10-89	No Perimeter Air Monitoring due to rain.			
11-11-89	111189-03	Station - 3	W	ND
	111189-05	- 5		ND
	111189-06	- 6		ND
11-13-89	111389-03	Station - 3	S-SE	<0.01
	111389-05	- 5		<0.01
	111389-06	- 6		ND
11-14-89	111489-03	Station - 3	N	<0.01
	111489-05	- 5		ND
	111489-06	- 6		<0.01
11-15-89	No Perimeter Air Monitoring due to rain.			
11-16-89	No Perimeter Air Monitoring due to rain.			
11-17-89	111789-03	Station - 3	SE to SW	<0.01
	111789-05	- 5		ND
	111789-06	- 6		<0.01

ND = Not Detected

Table 13B

PCM Results of Manville Trailer Air Monitoring for Asbestos

October 23 through November 17, 1989

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
10-23-89	102389-TRL	Inside Manville Trailer	<0.01
10-24-89	102489-TRL	"	ND
10-25-89	102589-TRL	"	<0.01
10-26-89	102689-TRL	"	ND
10-27-89	102789-TRL	"	<0.01
10-28-89	102889-TRL	"	<0.01
10-30-89	103089-TRL	"	<0.01
10-31-89	103189-TRL	"	<0.01
11-01-89	110189-TRL	"	<0.01
11-02-89	110289-TRL	"	<0.01
11-03-89	110389-TRL	"	<0.01
11-04-89	110489-TRL	"	ND
11-06-89	110689-TRL	"	<0.01
11-07-89	110789-TRL	"	0.03
11-08-89	110889-TRL	"	<0.01
11-09-89	110989-TRL	"	<0.01
11-10-89	111089-TRL	"	<0.01
11-11-89	111189-TRL	"	<0.01
11-13-89	111389-TRL	"	<0.01
11-14-89	111489-TRL	"	<0.01
11-15-89	111589-TRL	"	<0.01
11-16-89	111689-TRL	"	<0.01
11-17-89	111789-TRL	"	<0.01

ND = Not Detected

Table 13C

TEM Results of Remedial Construction Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results Fibers >5 um/cc	TEM Results All Size Fibers/cc
10-02-89 to 10-03-89	100289-06	Station - 6	E to NE	<0.01	0.1
10-24-89 to 10-25-89	102489-02	Station - 2	E	ND	ND

ND = Not Detected

<u>Table 14A</u>

PCM Results of Remedial Construction
Ambient Air Monitoring for Asbestos

November 18 through December 23, 1989

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Resu (Fibers/
11-18-89	No Perimeter Air Monitoring due to wet site conditions.			
11-20-89	No Perimeter Air Monitoring due to lack of site activity.			
11-21-89	112189-03	Station - 3	SE	ND
	112189-05	- 5		ND
	112189-06	- 6		ND
11-22-89	No Perimeter Air Monitoring due to snow and lack of activity.			
11-27-89	No Perimeter Air Monitoring due to wet site conditions.			
11-28-89	112889-03	Station - 3	N-NW	ND
	112889-05	- 5		<0.01
	112889-06	- 6		<0.01
	112889-BLK	- 3		ND
11-29-89	No Perimeter Air Monitoring due to frozen soil conditi on-site.			
11-30-89	113089-03	Station - 3	W-SW	<0.01
	113089-05	- 5		Void-Generator failure
	113089-06	- 6		<0.01
12-01-89	120189-03	Station - 3	W-SE	<0.01
	120189-05	- 5		<0.01
	120189-06	- 6		<0.01
12-02-89	120289-03	Station - 3	W-S	<0.01
	120289-05	- 5		<0.01
	120289-06	- 6		ND
12-04-89 through 12-09-89	No Perimeter Air Monitoring due to lack of soil disturbing site activity.			
12-11-89 through 12-13-89	No Perimeter Air Monitoring due to lack of soil distu site activity.			
12-14-89	No Perimeter Air Monitoring due to snow and lack of disturbing site activity.			
12-15-89 through 12-16-89	No Perimeter Air Monitoring due to extreme cold weatı. halted remedial activities.			

Table 14A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
12-18-89 through 12-20-89	No Perimeter Air Monitoring due to snow cover and lack of soil disturbing site activity.			
12-21-89 through 12-23-89	No Perimeter Air Monitoring due to extreme cold weather which halted remedial activities.			

ND = Not Detected

Table 14B

PCM Results of Manville Trailer Air Monitoring for Asbestos

November 18 through December 23, 1989

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
11-18-89	111889-TRL	Inside Manville Trailer	<0.01
11-20-89	112089-TRL	"	<0.01
11-21-89	112189-TRL	"	<0.01
11-22-89	112289-TRL	"	<0.01
11-27-89	112789-TRL	"	<0.01
11-28-89	112889-TRL	"	Void-Pump failure
11-29-89	112989-TRL	"	<0.01
11-30-89	113089-TRL	"	Void-Pump failure
12-01-89	120189-TRL	"	0.01
12-02-89	120289-TRL	"	0.01
12-04-89	120489-TRL	"	<0.01
12-05-89	120589-TRL	"	<0.01
12-06-89	120689-TRL	"	<0.01
12-07-89	120789-TRL	"	<0.01
12-08-89	120889-TRL	"	Void-Pump failure
12-09-89	120989-TRL	"	<0.01
12-11-89	121189-TRL	"	<0.01
12-12-89	121289-TRL	"	Void-Cassette problem
12-13-89	121389-TRL	"	<0.01
12-14-89	121489-TRL	"	<0.01

Table 14B
(Continued)

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
12-15-89 through 12-16-89	No Manville Trailer Air Monitoring due to extreme cold weather which halted remedial action.		
12-18-89	121889-TRL	Inside Manville Trailer	<0.01
12-19-89	121989-TRL	"	<0.01
12-20-89	122089-TRL	"	<0.01
12-21-89 through 12-23-89	No Manville Trailer Air Monitoring due to extreme cold weather which halted remedial action.		

Table 14C

TEM Results of Remedial Construction Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results Fibers >5 um/cc	All S Fibers
10-11-89 to 10-12-89	101189-06	Station - 6	SW	<0.01	<0.0
10-16-89 to 10-17-89	101689-03	Station - 3	W-NW	ND	<0.0
10-30-89 to 11-01-89	103089-02	Station - 2	SE	<0.01	<0.0
11-09-89 to 11-10-89	110989-03	Station - 3	SE to SW	ND	<0.0

ND = Not Detected

Table 15A

PCM Results of Remedial Construction Ambient Air Monitoring for Asbestos

January 2 through January 20, 1990

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
01-02-90	No Perimeter Air Monitoring due to lack of soil disturbing site activities.			
01-03-90	010390-02	Station - 2	S - SE	<0.01
	010390-03	- 3		<0.01
	010390-06	- 6		<0.01
	010390-BLK	- 3		ND
01-04-90	No Perimeter Air Monitoring due to poor conditions weather which halted remedial activities.			
01-05-90	010590-02	Station - 2	S - SE	<0.01
	010590-03	- 3		<0.01
	010590-06	- 6		ND
01-08-90 through 01-13-90	No Perimeter Air Monitoring due to poor weather conditions which halted remedial activities.			
01-15-90 through 01-20-90	No Perimeter Air Monitoring due to lack of soil disturbing site activities.			

ND = Not Detected

Table 15B

PCM Results of Manville Trailer Air Monitoring for Asbestos

January 2 through January 20, 1990

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
01-01-90	010290-TRL	Inside Manville Trailer	Void-Pump failure
01-03-90	010390-TRL	"	<0.01
01-04-90	010490-TRL	"	<0.01
01-05-90	010590-TRL	"	<0.01
01-06-90	010690-TRL	"	<0.01
01-08-90	010890-TRL	"	<0.01
01-09-90	010990-TRL	"	<0.01
01-10-90	011090-TRL	"	<0.01
01-11-90	011190-TRL	"	<0.01
01-12-90	011290-TRL	"	<0.01
01-13-90	011390-TRL	"	<0.01
01-15-90	011590-TRL	"	<0.01
01-16-90	011690-TRL	"	<0.01
01-17-90	011790-TRL	"	<0.01
01-18-90	011890-TRL	"	<0.01
01-19-90	011990-TRL	"	<0.01

Table 15C

TEM Results of Remedial Construction
Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	Fibers ≥5 um/cc	TEM Results All Size Fibers/cc
11-17-89 to 11-18-89	111789-06	Station - 6	SE to SW	<0.01	0.28
11-21-89 to 10-17-89	112189-03	Station - 3	SE	ND	<0.01
11-30-89 to 12-01-89	113089-03	Station - 3	W-SW	ND	ND

ND = Not Detected

Table 16A

PCM Results of Manville Trailer Air Monitoring

January 20 through February 16, 1990

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
01-20-90	012090-TRL	Inside Manville Trailer	<0.01
01-22-90	012290-TRL	"	<0.01
01-23-90	012390-TRL	"	<0.01
01-24-90	012490-TRL	"	<0.01
01-25-90 through 01-27-90		- No trailer air monitoring due to adverse we conditions which halted remedial construct	
01-29-90	012990-TRL	Inside Manville Trailer	<0.01
01-30-90	013090-TRL	"	<0.01
02-01-90	020190-TRL	"	<0.01
02-02-90 through 02-06-90		- No trailer air monitoring due to adverse we conditions which halted remedial condition	
02-07-90	020790-TRL	Inside Manville Trailer	<0.01
02-08-90 through 02-09-90		- No trailer air monitoring due to adverse we conditions which halted remedial construct	
02-10-90	021090-TRL	Inside Manville Trailer	<0.01
02-12-90	021290-TRL	"	<0.01
02-13-90	021390-TRL	"	<0.01
02-14-90	021490-TRL	"	<0.01
02-15-90		- No trailer air monitoring due to adverse we conditions which halted remedial cons	
02-16-90	021690-TRL	Inside Manville Trailer	<0.01

Table 16B

TEM Results of Remedial Construction Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results Fibers >5 um/cc	All Size Fibers/cc
01-03-90 to 01-04-90	010390-02	Station - 2	S - SE	ND	ND

ND = Non-Detected

Table 17A

PCM Results of Remedial Construction Ambient Air Monitoring for Total Fibers

March 21, 1990

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Re (Fiber
3-21-90	032190-02	Station - 2	SW-SE	<C
	032190-03	- 3		<C
	032190-06	- 6		<C

Table 17B

PCM Results of Manville Trailer Air Monitoring

March 17 through April 19, 1990

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
03-17-90	031790-TRL	Inside Manville Trailer	<0.01
03-19-90	031990-TRL	"	<0.01
03-20-90	032090-TRL	"	<0.01
03-21-90	032190-TRL	"	<0.01
03-22-90	032290-TRL	"	<0.01
	032290-BLK	"	ND
03-23-90	No Trailer sample collected. Adverse weather halted remedial activities on-site.		
03-26-90	032690-TRL	Inside Manville Trailer	Void-Filter Blown Out
03-27-90	032790-TRL	"	<0.01
	032790-BLK	"	ND
03-28-90	032890-TRL	"	<0.01
03-29-90	032990-TRL	"	<0.01
03-30-90	No Trailer sample collected. Adverse weather halted remedial activities on-site.		
03-31-90	033190-TRL	Inside Manville Trailer	<0.01
04-02-90	No Trailer sample collected. Adverse weather halted remedial activities on-site.		
04-03-90	No Trailer sample collected. Adverse weather halted remedial activities on-site.		
04-04-90	040490-TRL	Inside Manville Trailer	<0.01
04-05-90	040590-TRL	"	<0.01
04-06-90	040690-TRL	"	<0.01
04-07-90	040790-TRL		
04-09-90	040990-TRL	"	<0.01
	040990-BLK	"	ND

Table 17B
(Continued)

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
04-10-90	No Trailer sample collected. Adverse weather halted remedial activities on-site.		
04-11-90	No Trailer sample collected. Adverse weather halted remedial activities on-site.		
04-12-90	041290-TRL		Void - Pump failure
04-13-90	No Trailer sample collected due to lack of site activity.		
04-16-90	041690-TRL	Inside Manville Trailer	<0.01
	041690-BLK	"	ND
04-17-90	041790-TRL	"	<0.01
04-19-90	041990-TRL-1*	"	<0.01
	041990-TRL-2*	"	<0.01

ND = Not Detected

* = Two samples were labelled 041990-TRL. The Laboratory designated t and 2 and used the lowest volume of the two samples to calculate a case scenario.

Table 17C

TEM Results of Remedial Construction Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	TEM Results All Size Fibers	TEM Results > 5 um Fibers
03-21-90	032190-06	Station - 6	SW - SE	ND	ND

ND = Not Detected

Table 18A

PCM Results of Manville Trailer Air Monitoring

April 20 through May 3, 1990

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
04-20-90	No Trailer sample collected. Adverse weather halted remedial activities on-site.		
04-23-90	042390-TRL	Inside Manville Trailer	<0.01
04-24-90	042490-TRL	"	<0.01
04-25-90	042590-TRL	"	<0.01
04-26-90	042690-TRL	"	<0.01
	042690-BLK	"	ND
04-27-90	042790-TRL	"	<0.01
04-30-90	043090-TRL	"	<0.01
05-01-90	050190-TRL	"	<0.01
05-02-90	050290-TRL	"	<0.01
05-03-90	050390-TRL	"	<0.01

ND = Non-Detected

Table 19A

TEM Results of Remedial Construction Ambient Air Monitoring for Asbestos

August 14 through August 24, 1990

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
08-14-90	081490-02	Station - 2	W	ND
	081490-03	- 3		<0.01
	081490-06	- 6		<0.01
08-15-90	081590-A	*	SW	<0.01
	081590-B	*		<0.01
	081590-C	*		<0.01
08-16-90	081690-02	Station - 2	E	ND
	081690-03	- 3		<0.01
	081690-06	- 6		<0.01
08-17-90	081790-02	Station - 2	E	ND
	081790-03	- 3		Void - Filter fell apart
	081790-06	- 6		ND
08-20-90	No Perimeter air monitoring due to lack of soil disturbing site activity.			
08-21-90	No Perimeter air monitoring due to lack of soil disturbing site activity.			
08-22-90	No Perimeter air monitoring due to lack of soil disturbing site activity.			
08-23-90	082390-03	Station - 3	E	<0.02
08-24-90	082490-02	Station - 2	E	<0.01
	082490-03	- 3		<0.01
	082490-06	- 6		<0.01

ND = Not Detected

* = Samples received by the laboratory that did not contain any identifying labels. Fiber concentrations were calculated using the lowest sample volume of the day for a worst case scenario.

Table 19B

PCM Results of Manville Trailer Air Monitoring for Total Fibers

August 14 through August 24, 1990

Sampling Date	Sample Number	Sampling Station Location	PCM Resul (Fibers/c
08-14-90	081490-TRL	Inside Manville Trailer	<0.01
08-15-90	081590-TRL	Inside Manville Trailer	<0.01
08-16-90	081690-TRL	Inside Manville Trailer	<0.01
08-17-90	081790-TRL	Inside Manville Trailer	<0.01
08-20-90	082090-TRL	Inside Manville Trailer	<0.01
08-21-90	082190-TRL	Inside Manville Trailer	<0.01
08-22-90	082290-TRL	Inside Manville Trailer	<0.01
08-23-90	082390-TRL	Inside Manville Trailer	<0.01
08-24-90	082490-TRL	Inside Manville Trailer	<0.

Table 20A

PCM Results of Remedial Construction Ambient Air Monitoring for Total Fibers

August 27 through September 21, 1990

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
08-27-90	082790-02	Station - 2	E	<0.01
	082790-03	- 3		<0.01
	082790-06	- 6		<0.01
08-28-90	082890-02	Station - 2	N	<0.01
	082890-03	- 3		<0.01
	082890-06	- 6		<0.01
08-29-90	082990-02	Station - 2	N to W	<0.01
	082990-03	- 3		<0.01
	082990-06	- 6		<0.01
	082990-BLK			ND
08-30-90	083090-02	Station - 2	S to E	<0.01
	083090-03	- 3		<0.01
	083090-06	- 6		<0.01
08-31-90	083190-02	Station - 2	N to E	0.01
	083190-03	- 3		<0.01
	083190-06	- 6		<0.01
09-03-90	No Perimeter Ambient Air Monitoring Conducted due to Labor Day Holiday.			
09-04-90	090490-02	Station - 2	E to NE	<0.01
	090490-03	- 3		<0.01
	090490-06	- 6		Void - Generator failure
09-05-90	090590-02	Station - 2	SE	<0.01
	090590-03	- 3		<0.01
	090590-06	- 6		Void - Generator Failure
09-06-90	090690-02	Station - 2	E	<0.01
	090690-03	- 3		<0.01
	090690-06	- 6		<0.01
09-07-90	090790-02	Station - 2	S to SE	<0.01
	090790-03	- 3		<0.01
	090790-06	- 6		<0.01

Table 20A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Resu (Fibers/
09-10-90	091090-02	Station - 2	E to SE	Void -
	091090-03	- 3		Void -
	091090-06	- 6		Void -
09-11-90	091190-02	Station - 2	NE	
	091190-03	- 3		<
	091190-06	- 6		Vo Gener Fai
09-12-90	091290-02	Station - 2	S to W	<
	091290-03	- 3		<
	091290-06	- 6		Vo Gener fai
09-13-90	091390-02	Station - 2	S to E	<
	091390-03	- 3		<
	091390-06	- 6		
09-14-90	No Perimeter Ambient Air Monitoring conducted due to ra			
09-17-90	091790-02	Station - 2	S to E	<
	091790-03	- 3		<
	091790-06	- 6		<
09-18-90	091890-02	Station - 2	S	<
	091890-03	- 3		<
	091890-06	- 6		<
09-19-90	091990-02	Station - 2	S-SE	Vo Gener fai
	091990-03	- 3		<
	091990-06	- 6		
09-20-90	092090-02	Station - 2	S-SW	Vo Gener Fai
	092090-03	- 3		<
	092990-06	- 6		<
09-21-90	No Perimeter Ambient Air Monitoring conducted due to ra			

ND = Not Detected

Table 20B

Summary of Duplicate and Replicate PCM Analysis of Selected Air Samples

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
08-14-90	081490-02D	Station - 2	W	ND
08-17-90	081790-06D	Station - 6	E	<0.01
08-23-90	082390-03D	Station - 3	E	<0.01
08-29-90	082990-03D	Station - 3	N to W	Results Awaited
08-31-90	083190-06D	Station - 6	N to E	Results Awaited
09-04-90	090490-02D	Station - 2	E to NE	Results Awaited
09-11-90	091190-03D	Station - 3	NE	<0.01
08-14-90	081490-06R	Station - 6	W	<0.01
08-17-90	081790-02R	Station - 2	E	ND
08-24-90	082490-06R	Station - 6	E	<0.01
08-27-90	082790-02R	Station - 2	E	Results Awaited
08-30-90	083090-03R	Station - 3	S to E	Results Awaited
09-07-90	090790-06R	Station - 6	S to SE	Results Awaited
09-13-90	091390-06R	Station - 6	S to E	<0.01

ND = Not Detected

D = Duplicate Sample

R = Replicate Sample

Table 20C

PCM Results of Manville Trailer Air Monitoring for Total Fibers

August 27 through September 21, 1990

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc
08-27-90	082790-TRL	Inside Manville Trailer	<0.01
08-28-90	082890-TRL	"	<0.01
08-29-90	082990-TRL	"	<0.01
08-30-90	083090-TRL	"	<0.01
08-31-90	083190-TRL	"	<0.01
09-03-90	No Manville Trailer Air Monitoring due to Labor Day Holid		
09-04-90	090490-TRL	Inside Manville Trailer	0.01
09-05-90	090590-TRL	"	<0.01
09-06-90	090690-TRL	"	<0.01
09-07-90	090790-TRL	"	<0.01
09-10-90	091090-TRL	"	0.01
09-11-90	091190-TRL	"	<0.01
09-12-90	091290-TRL	Inside Manville Trailer	<0.01
09-13-90	091390-TRL	"	<0.01
09-14-90	No Manville Trailer Air Monitoring Due to Rain		
09-17-90	091790-TRL	Inside Manville Trailer	<0.01
09-18-90	091890-TRL	"	<0.01
09-19-90	091990-TRL	"	0.01
09-20-90	092090-TRL	"	<0.01
09-21-90	No Manville Trailer Air Monitoring Due to Rain		

Table 20D

TEM Results of Remedial Construction Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	Fibers >5 um/cc	All Size Fibers/cc
08-16-90 to 08-17-90	081690-03	Station - 3	E	<0.01	<0.01
08-24-90 to 08-25-90	082490-03	Station - 3	E	ND	ND
08-28-90 to 08-29-90	082890-03	Station - 3	N	ND	0.01
09-06-90 to 09-07-90	090690-03	Station - 3	E	<0.01	0.04
09-12-90 to 09-13-90	091290-02	Station - 2	S to W	<0.01	0.02

ND = Not Detected

Table 21A

PCM Results of Remedial Construction Ambient Air Monitoring for Total Fibers

September 24 through October 12, 1990

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Resu (Fibers/
09-24-90	092490-02	Station - 2	W - NW	<0.01
	092490-03	- 3		<0.01
	092490-06	- 6		<0.01
09-25-90	092590-02	Station - 2	W - SW	<0.01
	092590-03	- 3		<0.01
	092590-06	- 6		<0.01
09-26-90	092690-02	Station - 2	W - SW	<0.01
	092690-03	- 3		<0.01
	092790-06	- 6		ND
09-27-90	092790-02	Station - 2	S	<0.01
	092790-03	- 3		<0.01
	092790-06	- 6		'D
09-28-90 heavy	No Perimeter Ambient Air Monitoring was conducted due rain.			
10-01-90	100190-02	Station - 2	S - SW	<0.01
	100190-03	- 3		<0.01
	100190-06	- 6		<0.01
10-02-90	100290-02	Station - 2	S - SW	<0.01
	100290-03	- 3		<0.01
	100290-06	- 6		<0.01
10-03-90	No Perimeter Ambient Air Monitoring was conducted due lack of soil disturbing site activities.			
10-04-90	No Perimeter Ambient Air Monitoring was conducted due lack of soil disturbing site activities.			
10-05-90	100590-02	Station - 2	S	<0.01
	100590-03	- 3		ND
	100590-06	- 6		<0.01
10-08-90	No Perimeter Ambient Air Monitoring was conducted due heavy rain.			
10-09-90	No Perimeter Ambient Air Monitoring was conducted heavy rain.			

Table 21A
(Continued)

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Results (Fibers/cc)
10-10-90	No Perimeter Ambient Air Monitoring was conducted due to heavy rain.			
10-11-90	No Perimeter Ambient Air Monitoring was conducted due to wet site conditions.			
10-12-90	101290-02	Station - 2	Calm to E - SE	<0.01
	101290-03	- 3		<0.01
	101290-06	- 6		<0.01

ND = Not Detected

Table 21B

Summary of Duplicate and Replicate PCM Analysis of Selected Air Samples

Sampling Date	Sample Number	Sampling Station Location	Wind Direction	PCM Resul (Fibers/c
08-29-90	082990-03D	Station - 3	N to W	<0.01
08-31-90	083190-06D	Station - 6	N to E	<0.01
09-04-90	090490-02D	Station - 2	E to NE	<0.01
09-11-90	091190-03D	Station - 3	NE	<0.01
09-17-90	091790-06D	Station - 6	S to E	<0.01
09-24-90	092490-03D	Station - 3	W-NW	<0.01
09-27-90	092790-06D	Station - 6	S	ND
08-27-90	082790-02R	Station - 2	E	<0.01
08-30-90	083090-03R	Station - 3	S to E	<[illegible]
09-07-90	090790-06R	Station - 6	S to SE	<0.01
09-13-90	091390-06R	Station - 6	S to E	<0.01
09-20-90	092090-06R	Station - 6	S to SW	<0.01
09-25-90	092590-02R	Station - 2	W - SW	ND
09-26-90	092690-06R	Station - 6	W - SW	ND

ND = Not Detected

D = Duplicate Sample

R = Replicate Sample

Table 21C

PCM Results of Manville Trailer Air Monitoring for Total Fibers

September 24 through October 12, 1990

Sampling Date	Sample Number	Sampling Station Location	PCM Results (Fibers/cc)
09-24-90	092490-TRL	Inside Manville Trailer	<0.01
09-25-90	092590-TRL	"	<0.01
09-26-90	092690-TRL	"	<0.01
09-27-90	092790-TRL	"	<0.01
09-28-90	No Manville Trailer Air Monitoring due to rain.		
10-01-90	100190-TRL	Inside Manville Trailer	0.01
10-02-90	100290-TRL	"	<0.01
10-03-90	No Manville Trailer Air Monitoring due to rain.		
10-04-90	No Manville Trailer Air Monitoring due to rain.		
10-05-90	100590-TRL	Inside Manville Trailer	<0.01
10-08-90	No Manville Trailer Air Monitoring due to rain.		
10-09-90	No Manville Trailer Air Monitoring due to rain.		
10-10-90	No Manville Trailer Air Monitoring due to rain.		
10-11-90	No Manville Trailer Air Monitoring due to rain.		
10-12-90	101290-TRL	Inside Manville Trailer	<0.01

Table 21D

TEM Results of Remedial Construction Ambient Air Monitoring for Asbestos

Sampling Period	Sample Number	Sampling Station Location	Wind Direction	Fibers >5 um/cc	All Fibe
9-25-90 to 9-26-90	092590-03	Station - 3	W - SW	0.02	<.
10-02-90 to 10-03-90	100290-03	Station - 3	S - SW	ND	

ND = Not Detected

APPENDIX K

O'BRIEN LETTER TO ILLINOIS DEPARTMENT OF NUCLEAR SAFETY

CONESTOGA-ROVERS & ASSOCIATES
MEMORANDUM

TO:	File
FROM:	Samuel Jung
DATE:	March 14, 1990
REF. NO.	2980
RE:	O'Brien & Associates Response to CRA Letter Dated March 6, 1990

On March 12, 1990 CRA received the attached letter from O'Brien and Associates, Inc. regarding the elevated radiation exposure concern raised over the past several weeks. The letter was generated in response to our letter dated March 6, 1990 regarding the radiation readings made by Mr. E. Meyers, USEPA OSC on O'Brien and Associates soil testing equipment.

The attached letter explains the reasons why measurable radiation levels around the testing equipment, in its stored position were found, and discloses the reasons behind Nick Foltman's film badge over exposure.

As initially thought, and now verified, the elevated radiation measurements on Mr. Foltman's film badge were caused by his own equipment and Mr. Foltman's comments of February 1, 1990 to CRA regarding the possible existence of a radiation source at the Manville Site were made prematurely and without factual data.

The concern over a potential radiation source at the Manville Site was addressed in a previous memorandum to file.

SJ/lo/2

Attachment

cc: Richard Shepherd

'BRIEN & ASSOCIA'ES, INC.
CONSULTING ENGINEERS
1235 E. DAVIS ST/ARLINGTON HTS, IL 60005
(708) 398-1441 • FAX (708) 398-2376

2980

Rec'd CRA

MAR 12 1990

March 9, 1990

Conestoga-Rovers & Associates, Inc.
O'Hare Corporate Towers One
10400 West Higgins Road, Suite 103
Rosemont, IL 60018

Attn: Mr. Samuel Jung

Re: *Radiation Exposure, Manville Remedial Construction Work, Waukegan, Illinois*

Dear Mr. Jung:

In response to your letter dated March 6, 1990, Reference No. 2980, I would like to assure you that we were not using "faulty and potentially dangerous equipment" at your site. All nuclear density-moisture density gauges have basically the same design which utilizes a radioactive source material encased in a lead pellet which is located at the end of a source rod. In the "safe position" the rod is housed in another lead chamber which reduces the amount of external radiation, however, it does not block all emissions. The only effective method to reduce the amount of exposure to radioactive emissions is to maintain proper distances from the source itself. That is why when being transported, the gauge is typically kept to the rear of the vehicle and unauthorized users are urged to maintain a minimum distance of 3.0' from the gauge when the source rod is in the operate position.

Typical surface dose rates for various gauge sources range from 10 to 15 millirems per hour. The particular gauge that Mr. Foltman had at the Manville site on March 2, 1990, is a Seaman C-75 which has a source of 4.5 mCuries of Radium 226 and is rated for a maximum emission in the operate position of less than 10 millirems per hour at 6 inches and has an unshielded gamma emission of 1.6 millirems per hour at 1 meter. Regarding the levels measured by Mr. Megers on March 2, 1990, it should be noted that these readings are artificially high, although well within acceptable limits. Geiger counters are particularly sensitive to Radium sources and it is necessary to calibrate them specifically to Radium to obtain accurate emission readings.

Regarding the possibility of "leaking" radioactive materials, we are required to perform leak tests on all moisture-testing gauges twice a year. Included with this letter are the two latest leak tests for the gauge Mr. Foltman uses on a regular basis indicating that the gauge's source is intact.

Regarding the actual overexposure for Mr. Foltman's film badge, we have finally ascertained the probable cause. Please find enclosed the two letters sent to the Illinois Department of Nuclear Safety (IDNS) detailing our investigation for the overexposures. In the initial letter, it was postulated that the exposures were the result of improper film badge storage and in the follow up letter it was reported that we determined that Mr. Foltman had been storing the testing gauge in the truck cab when he was away from the vehicle. This resulted in the film badge, which he incorrectly kept in his briefcase, being in very close proximity to the gauge's Radium source. I would like to emphasize that at no time did we state to either IDNS or your office that the Manville property was the source of the exposures but that it was more likely the result of improper film badge usage by Mr. Foltman.

I hope this information satisfactorily addresses your concerns. If you have any questions, please do not hesitate to contact us.

Very truly yours,

O'BRIEN & ASSOCIATES, INC.

Vernon P. Brown

Vernon P. Brown
Radiation Safety Officer

VPB/jg

enclosures

TROXLER P O Box 12057, 3008 [illegible]allis Rd. Research Triangle Park, North [illegible]ina 27709, U.S.A.

Device - Model # Seaman C75, Serial # 2464

Source(s) - Serial # Ra 226 45mCi, Serial # ______

Date of Test: 8-14-89

Please print legibly and firmly

This is your return address label

- O'Brien & Assoc. Inc.
- 1235 - E Davis St.
- Arlington Hts, ILL. 60005
- Your Name: Vernon Brown

Telephone: (312) 398-1441

LEAK TEST ANALYSIS*

This certifies that the sample accompanying this form has been analyzed using an approved monitoring method that measures both beta/gamma & alpha contamination; and, that the results of this analysis shows the removable activity to be less than 0.005 microcuries.

Linda Upchurch

8-17-89

TROXLER P O Box 12057 3008 Cornwallis Rd. Research Triangle Park, North Carolina 27709, U.S.A.

Device - Model # Seaman C75, Serial # 2464

Source(s) - Serial # Ra226 45mCi, Serial # ______

Date of Test: 2-14-90

Please print legibly and firmly

This is your return address label

- O'Brien & Associates
- 1235 E Davis St.
- Arlington Heights, IL. 60005
- Your Name: Vern Brown

Telephone: (708) 398-1441

LEAK TEST ANALYSIS

This certifies that the sample accompanying this form has been analyzed using an approved monitoring method that measures both beta/gamma & alpha contamination; and, that the results of this analysis shows the removable activity to be less than 0.005 microcuries.

2-22-90

Sue Jenkins

'BRIEN & ASSOCIA ES, INC.
CONSULTING ENGINEERS
1235 E. DAVIS ST/ARLINGTON HTS, IL 60005
(708) 398-1441 • FAX (708) 398-2376

February 21, 1990

Illinois Dept. of Nuclear Safety
1035 Outer Park Drive
Springfield, IL 62704

Re: License # IL-00358-01, RMA-1 Report

Dear Gentlemen:

Please find enclosed a RM-1 report for Mr. Nick Foltman for the three month period from August 10 to November 11, 1989. The film badge reports indicate exposures as follows:

1. 8-10-89 to 9-9-89 : 4.380 REMS
2. 9-10-89 to 10-9-89 : 2.860 REMS
3. 10-10-89 to 11-9-89 : 1.110 REMS

Based on the type of gauges we use for testing, it is extremely unlikely that these exposures are from use of our moisture density gauges. Following is a summary of the investigation we have performed thus far.

When the initial badge report was received, Landauer was requested to re-evaluate Mr. Foltman's badge. Initial attempts to contact Mr. Foltman to inform and question him regarding this film badge were unsuccessful because he was not contacting the office on a regular basis since he was spending most of his time between various field jobs and reporting to Veteran's Hospital for medical evaluations. Landauer's re-evaluation of the film badge indicated that the reported exposure was accurate and there was no indication of heat damage. They also added that there was no filter pattern observed suggesting that the badge was exposed out of its holder. When contact was finally made with Mr. Foltman, he was unable to provide an explanation for the high measurement. The only possibility that occurred to him was that he had recently had a CATSCAN but did not recall having his badge on during this examination. When asked if he had possibly stored his badge with a testing gauge, he stated that he had not. Based on this information, it was presumed that the exposure measured was not correct. This was decided on the basis of the following facts:

1. No filter pattern: badge was always in holder, therefore, it seemed unlikely that the "no pattern" exposure could have occurred while the badge was in Mr. Foltman's possession.

2. Recent leak test (8-14-89) on Seaman gauge #2464, the only gauge used by Mr. Foltman, indicated the source was intact.

3. It is not believed to be possible to receive this type of exposure from normal testing gauge use. Typical monthly exposures reported by Seaman service personnel who work within arms length of gauges on a constant basis are less than 100 millirems.

Despite numerous requests to Mr. Foltman to return the September 10, 1989, badge to the office, he neglected to return the badge in time to be returned to Landauer for analysis. Apparently it was misplaced within his vehicle and was not found until the October badges were sent in for evaluation. For this reason it was not known until the return of the October 10 to November 9, 1989, film badge report on approximately December 6, 1989, that both of the next two month badges also had unacceptably high exposure levels. Landauer again was requested to re-evaluate the badges and reported that these badges showed no indication of heat damage and that the badge exposure readings were correct. Immediate contact was made with Mr. Foltman and he was still unable to provide a possible explanation for the reported exposures. When questioned about storage of his film badge during non-working hours, it was learned that he was keeping it either on the sun visor in his company vehicle or in his brief case which is kept in the vehicle. He was informed that when not in use the badge is supposed to be placed on the control badge board in our office as per O'Brien & Associates policy.

The only potentially suspect job site Mr. Foltman worked at where an exposure may have occurred noted in reviewing our job assignment records is the Johns Manville property in Waukegan, Illinois, where Mr. Foltman had been performing periodic field inspections. The work being performed at this site is the placement of a clay cover in an old disposal area. To the best of our knowledge, however, the only known hazardous materials associated with this property are asbestos materials. It is our understanding, as a result of contact with our office, the contractor at this site in conjunction with the Illinois EPA is looking into the possibility of radioactive materials being on site.

Based on the above information, it appears likely that the exposures noted are either the result of improper badge storage, exposure to some identified source or a combination of both. Considering that the badges for the months specified were kept in Mr. Foltman's company vehicle, it appears that the most likely explanation for the high exposures is the badge being exposed to sunlight and heat conditions within the vehicle's cab.

At this time we have been unable to explain the exposures noted on Mr. Foltman's film badges. However, in the course of our review of the facts, it was learned that Mr. Foltman was not following proper film badge care. He has been reminded that film badges are to be worn when using testing gauges, stored on the the film badge board when not using a gauge and that returning badges on approximately the 10th of the month is of utmost importance. He has also been informed that if he does not conform to these requirements, his status as a field inspector with our firm may be in jeopardy.

If you have any questions or need additional information, please do not hesitate to contact us.

Very truly yours,

O'BRIEN & ASSOCIATES, INC.

Vernon P. Brown

Vernon P. Brown
Radiation Safety Officer

VPB/jg

O'BRIEN & ASSOCIATES, INC.
CONSULTING ENGINEERS
1235 E. DAVIS ST/ARLINGTON HTS, IL 60005
(708) 398-1441 • FAX (708) 398-2376

March 2, 1990

Illinois Department of Nuclear Safety
1035 Outer Park Drive
Springfield, IL 62703

Re: License #IL-00358-01, Nick Foltman
RMA-1 Exposure Report

Gentlemen:

In my letter dated February 21, 1990, I detailed the investigation that had been performed regarding high dosages noted for Mr. Foltman's film badges for the 3 month period from August 10 to November 11, 1989. Since that letter was written, a probable cause for the high exposures has come to light. As mentioned in that letter, Mr. Foltman was improperly storing his film badge in his brief case on the passenger seat of his company truck. Upon further questioning, Mr. Foltman recalled that whenever he was away from his vehicle, he would lock the gauge, which was stored in its transportation case, in the vehicle's cab to deny access of the gauge to unauthorized personnel. When placing the gauge and case in the vehicle, Mr. Foltman would typically put the case directly on top of his brief case which would place the source rod within several inches of the film badge in his brief case. I believe this is the likely source of the exposures noted on the film badges in question.

Also mentioned in my February 21, 1990, letter was that the only suspect job site Mr. Foltman was performing inspections at was the Johns Manville site in Waukegan. It is my understanding that there was a recent geiger counter survey performed at this property and there were no suspect areas identified.

If you have any questions or need any additional information, do not hesitate to contact us.

Very truly yours,

O'BRIEN & ASSOCIATES, INC.

Vernon P. Brown

Vernon P. Brown
Radiation Safety Officer

VPB/jg

APPENDIX L

MISCELLANEOUS SOIL AND PROCESS WASTEWATER MONITORING DURING REMEDIAL ACTION, OCTOBER 1991, C. C. JOHNSON AND MALHOTRA, P.C.

MISCELLANEOUS SOIL
AND PROCESS WASTEWATER MONITORING
DURING REMEDIAL ACTION

AT

THE MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

November 1991

C.C. JOHNSON & MALHOTRA, P.C.
ENGINEERS AND SCIENTISTS
Quality Service Since 1979

Grand Rapids, Michigan

CCJM
ENVIRONMENTAL ENGINEERS & SCIENTISTS

SILVER SPRING
CHICAGO
DENVER
GRAND RAPIDS

Rec'd CRA
NOV 1

November 8, 1991

Mr. Richard Shepherd, P.E.
Conestoga, Rovers & Associates
O'Hare Corporate Tower 1
10400 West Higgins
Rosemont, Illinois 60018

RE: Pre-Remedial Construction Active Waste Disposal Areas Sampling and Miscellaneous Soil Sampling During Remedial Construction

Dear Mr. Shepherd:

This report summarizes the miscellaneous soil and process wastewater sampling activities and the associated remediation measures adopted at the Manville Disposal Area. All samples were collected in accordance with the Remedial Action Work Plan.

Please feel free to contact me if you have questions regarding the contents of this report.

Sincerely,

C.C. JOHNSON & MALHOTRA, P.C.

S. K. Malhotra, Ph.D., P.E.
Senior Vice President

C.C. JOHNSON & MALHOTRA, P.C.
3310 EAGLE PARK DR., NE, SUITE 101 • GRAND RAPIDS, MICHIGAN 49505 • (616) 940-2007

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Executive Summary

Sampling of the Active Waste Disposal Areas (process wastewater discharged to the Treatment Basins, Sludge Disposal Pit and the Miscellaneous Waste Disposal Pit) was conducted in accordance with the Remedial Action Work Plan.

The process wastewater was analyzed for organics and inorganics and the data obtained indicated that no additional pretreatment was warranted prior to its continued treatment at the Disposal Area. Asbestos sampling of the soil and waste materials at the Sludge Disposal Pit, the Miscellaneous Disposal Pit, and the Northeast Corner of the Manville Disposal, indicated that some areas of the property had asbestos containing material/soil at or near the surface. Upon U.S. EPA approval, all areas suspected of containing asbestos-containing waste materials were provided with soil and vegetative cover.

ACTIVE WASTE DISPOSAL AREAS AND MISCELLANEOUS SOIL SAMPLING

1.0 Introduction

Remedial activities at the Manville Disposal Area were initiated in 1988 in accordance with the Remedial Action Work Plan. An integral part of these activities was the Pre-Remedial Construction Sampling of active waste disposal areas (Sludge Disposal Pit, Miscellaneous Disposal Pit) for asbestos and process wastewater discharged to the Disposal Area for inorganics and organics (Figure 1).

This report discusses sampling locations, sampling and analytical techniques, analytical results, findings, and recommended remedial action(s) for each area investigated.

2.0 Pre-Remedial Construction Sampling of Active Waste Disposal Areas

A number of active waste disposal areas at the remedial site were either investigated adequately or partially during the RI. Additional data was needed to access the need, if any, for remediation of these areas. This section discusses the sampling activities conducted and presents a summary of the findings and recommendations for each of the three active waste disposal areas.

2.1 Process Wastewater Sampling

Process wastewater from the manufacturing facilities and some of the storm water from the plant is discharged to the treatment basins located on the remedial construction site at two locations (Figure 1). The influent to the treatment basins was sampled in October 1988. A 24-hour flow proportional composite sample was collected from each location for organics (volatiles, semi-volatiles, PCBs and PBBs) and metal (chromium, lead, arsenic, antimony, and aluminum) analysis using the procedures outlined in QAPP for Remedial

MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

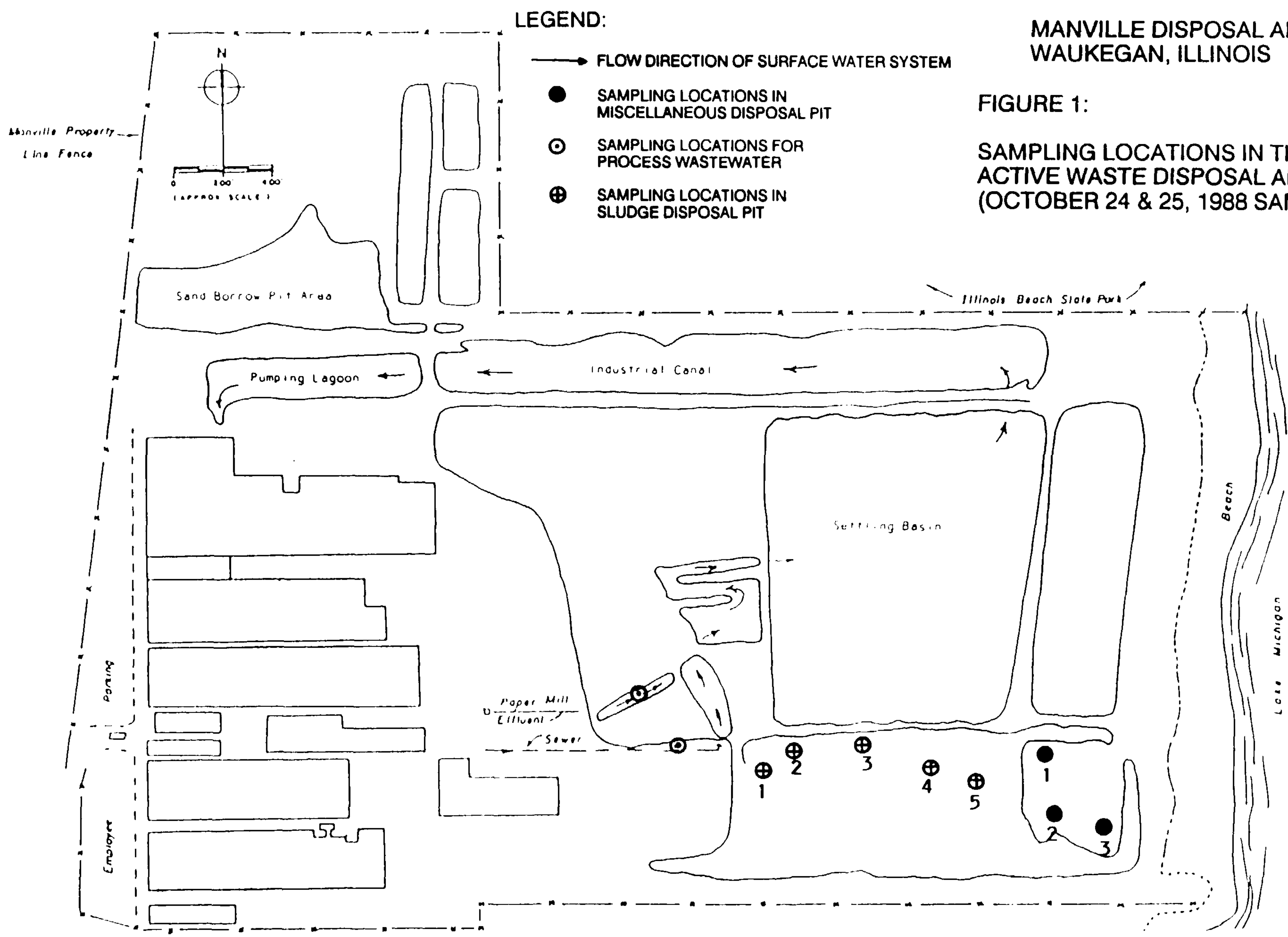


FIGURE 1:

SAMPLING LOCATIONS IN THE ACTIVE WASTE DISPOSAL AREAS (OCTOBER 24 & 25, 1988 SAMPLING)

Action. The results obtained are summarized in Tables 1 and 2. A review of the data concerning the process wastewater quality indicated that the combined process wastewater did not contain any hazardous contaminants at levels which would have any adverse impacts on the site and the environment. Therefore, no additional pretreatment of the process wastewater at the Disposal Site Area was required.

2.2 Sludge Disposal Pit and Miscellaneous Disposal Pit Sampling

The Sludge Disposal Pit had been used for the disposal of sludge periodically dredged from the settling basins used to treat the process wastewater.

The Miscellaneous Disposal Pit has been, and is currently being used for the disposal of solid manufacturing wastes.

On October 24 and 25, 1988, surface (0' to 1.0') and subsurface (1.0' to 2.0') sludge and waste material samples were collected from five locations in the Sludge Disposal Pit (SDP) and three locations in the Miscellaneous Disposal Pit (MDP), respectively. These sampling locations are shown on Figure 1. Sampling and analytical procedures conducted were according to the QAPP for Remedial Action. A summary of the asbestos results is presented in Table 3. Table 3 includes the weights of the fine (<0.5 mm size) and coarse (>0.5 mm size) fractions of each sample, the asbestos content of each fraction, and the total weighted average total asbestos content.

Two of the eleven sludge samples collected from the Sludge Disposal Pit (Table 3) indicated the presence of about 2 percent of asbestos. Both of these samples were from the eastern one third of the Sludge Disposal Pit. Asbestos in all other Sludge Disposal Pit samples was either non-detected or less than one percent. Upon U.S. EPA approval, the Sludge Disposal Pit was provided with a soil and vegetative cover.

Table 1
Summary of Organics Detected in Active Wastewater Streams
(Samples Collected in October, 1988)

Sampling Location	Detected Organic Compound	Concentration ug/l	Comments
#1 (Influent to Black Ditch)	ND	NA	-
#1-D (Influent to Black Ditch)	ND	NA	-
			-
#2 (Paper Mill Effluent)	Di-n-octylphthalate	20	Plastic funnel used during sampling. Also present in field blank.
Field Blank	Bis (2-ethylhexyl) phthalate	10	Plastic funnel used during sampling.
Trip Blank	ND	NA	--

ND = None Detected
NA = Not Applicable
D = Duplicate Sample

Table 2
Summary of Inorganics in Active Wastewater Streams
(Samples Collected in October, 1988)

Compound	Black Ditch	Papermill Effluent
Aluminum	746.00/850.00*	195.00
Antimony	<13.70	110.00
Arsenic	<1.50	137.00
Chromium	<2.80	31.90
Lead	7.04/4.60*	59.30

*Duplicate

ND = None Detected
NA = Not Applicable

Table 3
Asbestos in Sludge Samples from Active Waste Disposal Areas
(Sludge Disposal Pit and Miscellaneous Disposal Pit)

Sample Number	Sample Depth (in feet)	Weight of Sample Fractions in Grams	Asbestos Fiber (in Percent) Chrysotile	Crodicolite	Amosite	Total Asbestos (Weighted Average in Percent)
SDP-01-01	0-1	f-0.27	–	–	–	–
		c-0.73	–	–	–	
SDP-01-02	1-2	f-0.26	–	–	–	–
		c-0.74	–	–	–	
SDP-02-01	0-1	f-0.16	<<1	–	–	–
		c-0.84	–	–	–	
SDP-02-01-D	0-1	f-0.41	–	–	–	–
		c-0.59	<<1	–	–	
SDP-02-02	1-2	f-0.19	–	–	–	–
		c-0.81	–	–	–	
SDP-03-01	0-1	f-0.25	–	–	–	–
		c-0.75	–	–	–	
SDP-03-02	1-2	f-0.22	–	–	<<1	–
		c-0.78	–	–	–	
SDP-04-01	0-1	f-0.49	<1	–	–	2.02
		c-0.51	3	–	–	
SDP-04-02	1-2	f-0.42	<1	–	–	0.42
		c-0.58	–	–	–	
SDP-05-01	0-1	f-0.22	<<1	<<1	–	–
		c-0.78	<<1	–	<<1	
SDP-05-02	1-2	f-0.11	<1	–	<1	2.89
		c-0.89	<1	<1	<1	
MDP-01-01	0-1	f-0.17	<1	<<1	<<1	1.0
		c-0.83	<1	–	<<1	

Table 3 – Continued
Asbestos in Sludge Samples from Active Waste Disposal Areas
(Sludge Disposal Pit and Miscellaneous Disposal Pit)

Sample Number	Sample Depth (in feet)	Weight of Sample Fractions in Grams	Asbestos Fiber (in Percent)			Total Asbestos (Weighted Average in Percent)
			Chrysotile	Crodicolite	Amosite	
MDP-01-02	1-2	f-0.16	<1	–	–	1.0
		c-0.84	<1	–	<<1	
MDP-02-01	0-1	f-0.27	<1	<<1	<1	2.73
		c-0.73	1	<1	<1	
MDP-02-02	1-2	f-0.23	1	–	<1	1.23
		c-0.77	<1	–	–	
MDP-03-01	0-1	f-0.06	1+	<<1	1	3.88
		c-0.94	2+	<<1	2+	
MDP-03-01-D	0-1	f-0.24	<1	<1	<1	3.0
		c-0.76	<1	<1	1	
MDP-03-02	1-2	f-0.11	<1	<1	<1	3.89
		c-0.89	1+	2+	<1	

SDP = Sludge Disposal Pit

MDP = Miscellaneous Disposal Pit

D = Duplicate

f = fine, <0.5 mm size

c = coarse, >0.5 mm size

– = None detected

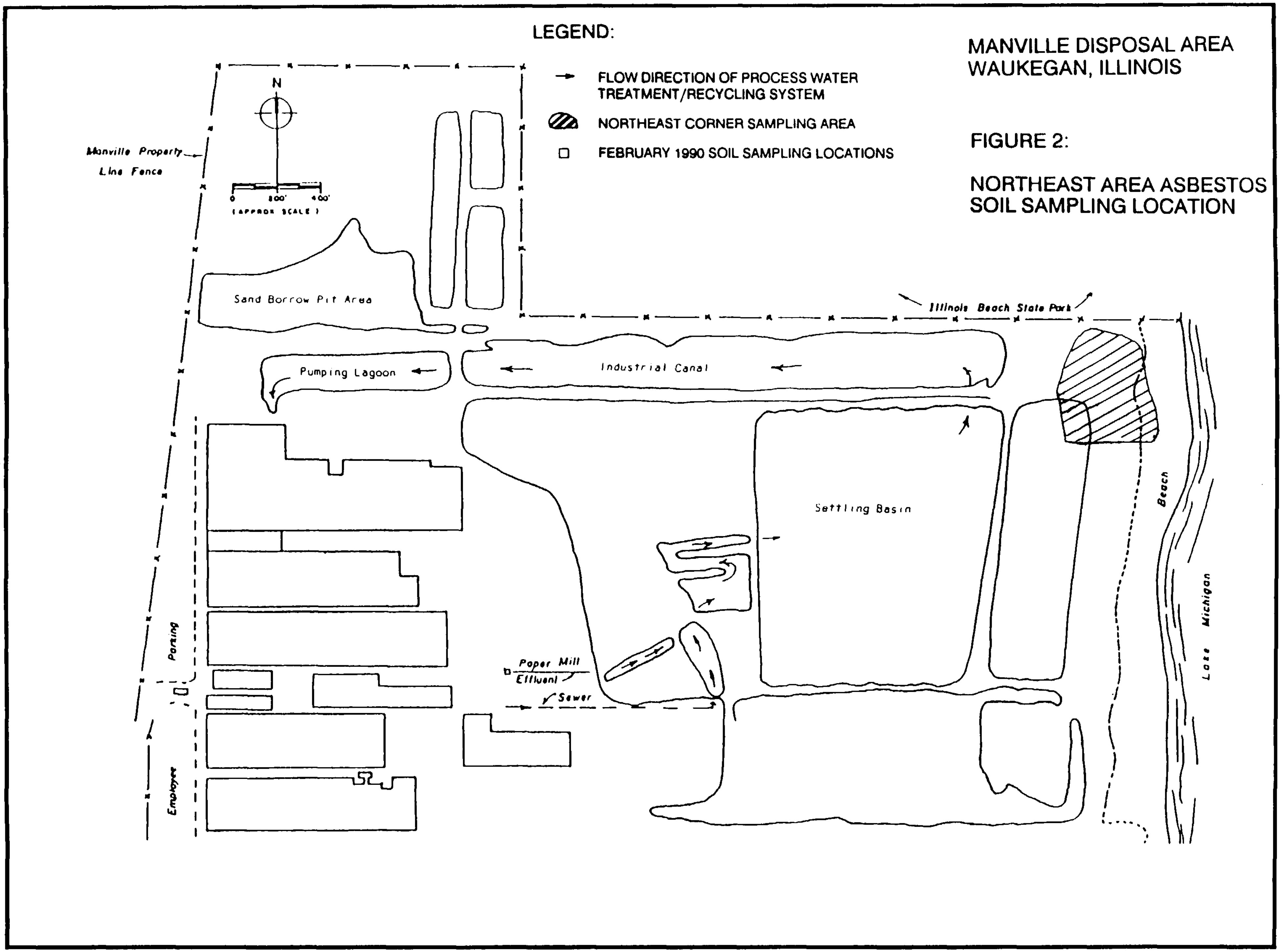
Four of the seven samples of soil/waste material from the Miscellaneous Disposal Pit (Table 3) indicated the presence of about 3 $\pm$ percent asbestos. Asbestos in all other Miscellaneous Disposal Pit waste material samples was less than 1.5 percent. It should be further noted that the above reported asbestos results are conservative estimates. Less than 1 percent of asbestos was counted as 1 percent in the calculation of total weighted average asbestos level in a sample. Upon U.S. EPA approval, the areas of the Miscellaneous Disposal Pit suspected to contain asbestos-containing waste materials were provided with soil cover.

3.0 Northeast Area Soil Sampling

The northeast area of the Disposal Site was not sampled for asbestos during RI, but was suspected to contain asbestos-containing materials. The surface soil from the northeast corner of the site (Figure 2) was sampled for bulk asbestos analysis during the Remedial Construction. A single sample of surficial material from random locations in the northeast area was collected by Thomas R. Morrison (CCJM Field Technician) on February 24, 1989. Sampling and analytical procedures followed were in accordance with the Work Plan and QAPP for Remedial Action.

The sample collected was shipped to EMS Laboratories for bulk asbestos analysis. This sample contained approximately 2.29 percent asbestos. The reported asbestos amount is a conservative estimate because a minimum fiber count of 1 percent was used for each detected asbestos constituent when calculating the weighted average asbestos level for the sample.

Upon U.S. EPA approval, the northeast portion of the Disposal Area suspected of asbestos containing materials was provided with a soil cover. Grass was planted and a vegetative cover was subsequently established.


LEGEND:
FLOW DIRECTION OF PROCESS WATER TREATMENT/RECYCLING SYSTEM
NORTHEAST CORNER SAMPLING AREA
FEBRUARY 1990 SOIL SAMPLING LOCATIONS
MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS
FIGURE 2:
NORTHEAST AREA ASBESTOS SOIL SAMPLING LOCATION
N
Manville Property Line Fence
Sand Borrow Pit Area
Pumping Lagoon
Industrial Canal
Illinois Beach State Park
Settling Basin
Paper Mill Effluent
Sewer
Parking
Employee
Beach
Lake Michigan

APPENDIX M

MISCELLANEOUS LIQUID SAMPLE DATA

Analysis of Water by Transmission Electron Microscopy
(EPA-600/4-80-005)

MS No. T-1653 Client C.C. JOHNSON & MALHOTRA

Sample No. MRA-SWRO-03A

Date 6/15/89

Fibers (chrysotile)	1300	MFL
Fibers > 5 µm in length (chrysotile)	12	MFL
Fibers > 10 µm in length (chrysotile)	0	MFL
Mass (chrysotile)	20	ug/L
More/Less than 5 Fibers in Sample (chrysotile)	MORE	
Poisson 95% Confidence Interval	1100 to 1600	MFL
Detection Limit	12	MFL

Particle Size Distribution (Chrysotile)

Particle Length - Microns

0 -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 & UP
11	38	23	12	8	18

Particle Width - Microns

0 - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 & UP
2	102	3	3	0	0

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 & UP
13	39	23	16	6	13

Analysis of Water by Transmission Electron Microscopy
(EPA-600/4-80-005)

.MS No.	T-1653	Client	C.C. JOHNSON & MALHOTRA
Sample No.	MRA-SWRO-03A		
Date	6/15/89		

at Lower Magnification
NOT ACCORDING TO SPECS & METHOD PRESCRIBED, ONLY >10 μm FIBERS COUNTED! HENCE NOT USED OR REPORTED

Fibers > 10 μm in length (chrysotile)	8.6	MFL
Mass (chrysotile)	1.5	ug/L
More/Less tnan 5 Fibers In Sample (chrysotile)	LESS	
Poisson 95% Confidence Interval	0.9 to 31	MFL
Detection Limit	4.3	MFL

Particle Size Distribution (Chrysotile)

Particle Length - Microns

O -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 & UP
0	0	0	0	0	2

Particle Width - Microns

O - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 & UP
0	2	0	0	0	0

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 & UP
0	0	0	0	0	2

Anal[illegible] of Water by Transmission Elect[illegible] Microscopy
(EPA-600/4-80-005)

EMS No.	T-1783	Client	C.C. JOHNSON & MALHOTRA
Sample No.	MRA-SWIC-01	Reference	
Date Analyzed	8/29/89	Date Prepared	8/17/89

Fibers (chrysotile)	250	MFL
Fibers > 5 µm in length (chrysotile)	7.1	MFL
Fibers > 10 µm in length (chrysotile)	2.4	MFL
Mass (chrysotile)	9.5	ug/L
More/Less than 5 Fibers in Sample (chrysotile)	MORE	
Poisson 95% Confidence Interval	210 to 310	MFL
Detection Limit	2.4	MFL

Particle Size Distribution (Chrysotile)

Particle Length - Microns

0 -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 - 4.99	5.00 - 9.99	10 & UP
6	48	22	10	12	9	2	1

Particle Width - Microns

0 - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 - .49	.50 - .99	1 & UP
0	99	7	1	0	1	0	0

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 - 99	100 - 199	200 & UP
7	50	22	10	10	7	2	0

Results of Industrial Canal Water Sampling

Analysis of Water by Transmission Electron Microscopy
(EPA-600/4-80-005)

EMS No. T-1783

Sample No. MRA-SWIC-02

Date Analyzed 9/1/89

Client C.C. JOHNSON & MALHOTRA

Reference

Date Prepared 8/17/89

Fibers (chrysotile)	160	MFL
Fibers > 5 µm in length (chrysotile)	11	MFL
Fibers > 10 µm in length (chrysotile)	0	MFL
Mass (chrysotile)	2.2	ug/L
More/Less than 5 Fibers in Sample (chrysotile)	MORE	
Poisson 95% Confidence Interval	130 to 200	MFL
Detection Limit	1.8	MFL

Particle Size Distribution (Chrysotile)

Particle Length - Microns

0 -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 - 4.99	5.00 - 9.99	10 & UP
8	25	21	15	8	10	6	0

Particle Width - Microns

0 - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 - .49	.50 - .99	1 & UP
0	88	3	1	1	0	0	0

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 - 99	100 - 199	200 & UP
11	26	20	15	6	9	6	0

Analysis of ater by Transmission Electron . croscopy
(EPA-600/4-80-005)

EMS No. T-1783 Date 8/30/89

Reference

Client C.C. JOHNSON & MALHOTRA

Sample No. EMS BLANK

Fibers (chrysotile)	ND	MFL
> 5 Micron length (chrysotile)	ND	MFL
Mass (chrysotile)	0	ug/L
More/Less than 5 Fibers in Sample (chrysotile)	LESS	
Sensitivity Level	0.04	MFL

Particle Size Distribution (Chrysotile)

Particle Length - Microns

O -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 & UP
0	0	0	0	0	0

Particle Width - Microns

O - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 & UP
0	0	0	0	0	0

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 & UP
0	0	0	0	0	0

SUBMITTAL FORM/*For Air Samples*

RUSH: YES ☐ NO ☐ Other ☐
<8hr ☐ 24hr ☐ 48hr ☐ Weekend ☐

- ►Client Manville Sales Corp
- ►Address Sands : Waukegan Ave's. Waukegan IL 60087
- ►Telephone 312 623-0437
- ►Contact Randy Mattzela
- ►Date of Shipment 8/16/89 ►Carrier Fed Ex
- ►Package Shipped From Waukegan
- ►Job No.
- ►Purchase Order No.
- ►Project ID

►Results Requested Via VERBAL ☐ FAX ☐ ►Client FAX No.
(NOTE: Complete written reports will follow all analyses, in addition to any prior transmitted verbal or fax results.)

- ►No. of Samples Sent 2
- ►Comments analyze water for asbestos
- ►Cassette Lot No.
- ►Manufacturer ►Distributor
- ►Filter Diameter(mm) 25mm ☐ 37mm ☐
- ►Filter Lot No.
- ►5.0µm Diffusion Filter Lot No.
- ►Manufacturer ►Distributor
- ►PCM ☐ *TEM ☐ SEM ☐
- ►Counting Rules

(*NOTE: Cassettes and filters supplied by EMS for TEM analysis are tested by batch to be asbestos-free.)

No.	Description	Screen or Membrane PC	Screen or Membrane MCE	Pore Size (µm)	Sample Volume (liters)	Receiving ID No.	Assigned No.
1	Water Sample					MRA-SWIC-01	
2	Water Sample					MRA-SWIC-02	

- ►Laboratory No.
- ►Date of Package Delivery
- ►Received By ►Time
- ►Shipping Bill Retained: YES ☐ NONE ☐
- Condition of Package on Receipt
- ►Condition of Custody Seal

(NOTE: If the package has sustained substantial damage or the custody seal is broken, stop and contact the project manager and the shipper.)

- ►No. of Samples
- ►Date of Acceptance into Sample Bank
- ►Disposition of Samples
- ►Chain-of-Custody Signature
- ►Comments

... Johnson & Malhotra, P.C.
1 Eagle Park Drive, N.E., Suite #101
... Rapids, MI 49505

(616) 940-2067

To: Ms Bernie Kolk
EMS Labs
507 Mission St
South Pasadena, CA 91030

pg 1 of

Proj. No.: 651

Project Name: Manville Waukegan

Samplers: (Signature) Randall L Mattget

Sample No.	Date	Time	Comp.	Grab	Station Location	No. of containers	~~[illegible]~~	~~[illegible]~~	Asbestos			Remarks
					MRA-SWIC-01	1			X			water sample
					MRA-SWIC-02	1			X			water sample

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Randall L Mattget	8/16/89 10:20				

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks

PARTICLE DATA LABORATORIES, LTD.

115 Hann Street • Elmhurst, Illinois 60126 • (312) 832-5658

September 8, 1989

Ms. Therese Dorigan
Conestoga-Rovers & Associates
10400 Higgins Road
Suite 103
Rosemont, Illinois 60018

RE: P.O. 2980 - Manville Site Remediation

Date Submitted: September 6, 1989

PDL Project: TEM 007

Dear Ms. Dorigan:

The following report concerns the 3 samples submitted for standard transmission electron microscopy to Particle Data Laboratories, Ltd.

The calibration factor relates the sample air volume and filter area evaluated. The results are enclosed on the attached sheet.

Thank you for consulting Particle Data Laboratories, Ltd. in this matter. If you have any questions concerning this report or the results, please feel free to contact us at 832-5653.

Respectfully submitted,

PARTICLE DATA LABORATORIES, LTD.

Michael Ganea, Ph.D.
Microscopist

Enclosure

PARTICLE DATA LABORATORIES, LTD.
115 HAHN STREET
ELMHURST, IL 60126
TELEPHONE 312/832-5658

TEM ASBESTOS ANALYSIS   Date: 9/08/89

Water Sample

PDL PROJECT: TEM 007

CLIENT: CONESTOGA-ROVERS & ASSOC.

Sample Designation: L2980-090589-SJ-013

Magnification: 20,000

Detection Limit: 0.1 Million Fibers/Liter

No of asbestos fibers > 5um detected: 2

No of asbestos fibers < 5um detected: 1

Asbestos fibers concentration in Millions/Liter: 0.3

PARTICLE DATA LABORATORIES, LTD.
115 HAHN STREET
ELMHURST, IL 60126
TELEPHONE 312/832-5658

TEM ASBESTOS ANALYSIS   Date: 9/08/89

Water Sample

PDL PROJECT: TEM 007

CLIENT: CONESTOGA-ROVERS & ASSOC.

Sample Designation: L2980-090689-SJ-014

Magnification: 20,000

Detection Limit: 0.1 Million Fibers/Liter

No of asbestos fibers > 5um detected: 0

No of asbestos fibers < 5um detected: 0

Asbestos fibers concentration in Millions/Liter: < 0.1

PARTICLE DATA LABORATORIES, LTD.
115 HAHN STREET
ELMHURST, IL 60126
TELEPHONE 312/832-5658

TEM ASBESTOS ANALYSIS Date: 9/08/89

Water Sample

PDL PROJECT: TEM 007

CLIENT: CONESTOGA-ROVERS & ASSOC.

Sample Designation: L2980-090689-SJ-015

Magnification: 20,000

Detection Limit: 0.1 Million Fibers/Liter

No of asbestos fibers > 5um detected: 0

No of asbestos fibers < 5um detected: 4

Asbestos fibers concentration in Millions/Liter: 0.4

TEM 007 SEP 06 1989

CRA Consulting Engineers **CONESTOGA-ROVERS & ASSOCIATES** 651 Colby Drive, Waterloo, Ontario Canada N2V 1C2	SHIPPED TO (Laboratory name): PARTICLE DATA

CHAIN OF CUSTODY RECORD	PROJECT Nº: 2980	PROJECT NAME: Manville Site Remediation

SAMPLER'S SIGNATURE (SIGN)

SEQ. Nº	~~SAMPLE Nº~~	DATE	TIME	SAMPLE ~~LOCATOIN~~ ID	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
1	—	9/5/89	1630	L2980-090589-SS-013	LIQUID	1	TEM ASBESTOS
							- Rush Turnaround
							(24 hours)
							9-5-89
				TOTAL NUMBER OF CONTAINERS		1	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY:	DATE/TIME	RECEIVED BY:
1 (SIGN)	9/5/89 1700	2 Walter Park (SIGN)
2 Walter Park (SIGN)	9/5/89 1810	3 (SIGN)
3 (SIGN)		4 (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: ~~OVERNIGHT~~	SHIPPED BY:	RECEIVED FOR LABORATORY BY: (SIGN) Carol Letson	DATE/TIME 9/6/89 9:07 AM
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN) Carol Letson	DATE/TIME 9/6/89 9:10 A.M.

WHITE – CRA OFFICE COPY
YELLOW – RECEIVING LABORATORY COPY
PINK – CRA LABORATORY COPY
GOLDEN ROD – SHIPPERS

Nº 005984

SEP 06 1989 TEM 007

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): PARTICLE DATA

CHAIN OF CUSTODY RECORD

PROJECT №: 2980

PROJECT NAME: Manville Site Remediation

SAMPLER'S SIGNATURE (SIGN)

SEQ. №.	~~SAMPLE №~~	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	№ OF CONTAINERS	REMARKS
1	—	9/6/89	1029	L2980-090689-SJ-014	LIQUID	1	TEM Asbestos
2	—	9/6/89	1032	L2980-090689-SJ-015	LIQUID	1	TEM Asbestos
							24 hour RUSH on BOTH SAMPLES
						9-7-89	
				TOTAL NUMBER OF CONTAINERS		2	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY:	DATE/TIME	RECEIVED BY:
1 (SIGN)	9/6/89 | 11:00	2 (SIGN)
RELINQUISHED BY: 2 (SIGN)	DATE/TIME	RECEIVED BY: 3 (SIGN)
RELINQUISHED BY: 3 (SIGN)	DATE/TIME	RECEIVED BY: 4 (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT:	SHIPPED BY:	RECEIVED FOR LABORATORY BY:	DATE/TIME
		(SIGN) Carol Lotson	9/6/89 | 3:45 PM
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN)	DATE/TIME

WHITE – CRA OFFICE COPY
YELLOW – RECEIVING LABORATORY COPY
PINK – CRA LABORATORY COPY
GOLDEN ROD – SHIPPERS

№ 005975

PARTICLE DATA LABORATORIES, LTD.

115 Hahn Street • Elmhurst, Illinois 60126 • (312) 832-5658

September 20, 1989

Mr. Dave Dempsey
Conestoga-Rovers & Associates
10400 W. Higgins Road
Suite 103
Rosemont, Illinois 60018

RE: P.O. #2980 - Manville Waukegan

Date Submitted: September 13, 1989

PDL Project: TEM 007

Dear Mr. Dempsey:

The following report concerns the 1 samples submitted for standard transmission electron microscopy to Particle Data Laboratories, Ltd.

The calibration factor relates the sample air volume and filter area evaluated. The results are enclosed on the attached sheet.

Thank you for consulting Particle Data Laboratories, Ltd. in this matter. If you have any questions concerning this report or the results, please feel free to contact us at 832-5653.

Respectfully submitted,

PARTICLE DATA LABORATORIES, LTD.

Michael Ganea /jf

Michael Ganea, Ph.D.
Microscopist

Enclosure

PARTICLE DATA LABORATORIES, LTD.
115 HAHN STREET
ELMHURST, IL 60126
TELEPHONE 312/832-5658

TEM ASBESTOS ANALYSIS Date: 9/16/89

Water Sample

PDL PROJECT: TEM 007

CLIENT: CONESTOGA-ROVERS & ASSOC.

Sample Designation: L2980-091289-SJ-016

Magnification: 20,000

Detection Limit: 0.2 Million Fibers/Liter
No of Asbestos Fibers >10 um Detected: 0
No of asbestos fibers > 5um detected: 2

No of asbestos fibers < 5um detected: 4

Asbestos fibers concentration in Millions/Liter: 1.2 MFL

SEP 1? 1989 TEM 007

CRA Consulting Engineers CONESTOGA-ROVERS & ASSOCIATES 651 Colby Drive, Waterloo, Ontario Canada N2V 1C2	SHIPPED TO (Laboratory name): PARTICLE DATA

CHAIN OF CUSTODY RECORD	PROJECT №: 2980	PROJECT NAME: MANVILLE, WAUKEGAN

SAMPLER'S SIGNATURE (SIGN)

SEQ. №	~~SAMPLE №~~	DATE	TIME	SAMPLE ~~LOCATOIN~~ ID	SAMPLE TYPE	№ OF CONTAINERS	REMARKS
1	—	9-12-89	1400	L2980-091289-SJ-016	LIQUID	1	Asbestos - TEM
							VERBAL RESULTS by FRIDAY 9/15/89
							WRITTEN RESULTS By 9/20/89
			TOTAL NUMBER OF CONTAINERS			1	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY:	DATE/TIME	RECEIVED BY:
1 (SIGN)	9-13-89 / 1913	2 (SIGN)
2 (SIGN)	9/14/89 /	3 (SIGN)
3 (SIGN)	/	4 (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT:	SHIPPED BY:	RECEIVED FOR LABORATORY BY:	DATE/TIME
HAND DELIVERED		(SIGN) Carol Letson	9/13/89 8:30 A.M.
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN)	DATE/TIME /

WHITE - CRA OFFICE COPY
YELLOW - RECEIVING LABORATORY COPY
PINK - CRA LABORATORY COPY
GOLDEN ROD - SHIPPERS

№ 005986

DATE: September 20, 1989

CLIENT: C.C. Johnson & Malhotra
3310 Eagle Park Drive, #101
Grand Rapids, MI 49505

ATTENTION: Chetan Trivedi

REFERENCE: Manville Waukegan

REPORT NO: T-1861

SUBJECT: ANALYSIS OF WATER SAMPLE FOR ASBESTOS BY TRANSMISSION ELECTRON MICROSCOPY

EMS LABORATORIES

EMS Laboratories, Inc., was instructed to analyze water sample L2980-091289-SJ-016. This sample was prepared and analyzed according to "The Interim Method for Determining Asbestos in Water," EPA-600/4-80-005".

The test reports are enclosed.

Respectfully submitted,

EMS LABORATORIES, INC.

B M Kolk

B.M. Kolk
Laboratory Director

BMK/mc
ems55

507 Mission Street
South Pasadena, CA
91030-3035
818-441-2393

Analys of Water by Transmission Electr Microscopy
(EPA-600/4-80-005)

MS No.	T-1861	**Client**	C.C JOHNSON &MALHOTRA
Sample No.	L2980-091289-SJ-016	**Reference**	M-W
Date Analyzed	9/15/89	**Date Prepared**	9/13/89

Fibers (chrysotile)	960	MFL
Fibers > 5 µm in length (chrysotile)	21	MFL
Fibers > 10 µm in length (chrysotile)	6.9	MFL
Mass (chrysotile)	12	ug/L
More/Less than 5 Fibers in Sample (chrysotile)	MORE	
Poisson 95% Confidence Interval	820 to 1100	MFL
Detection Limit	6.9	MFL

Particle Size Distribution (Chrysotile)

Particle Length - Microns

O -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 - 4.99	5.00 - 9.99	10 & UP
6	59	33	15	11	11	2	1

Particle Width - Microns

O - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 - .49	.50 - .99	1 & UP
0	130	7	1	0	0	0	0

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 - 99	100 - 199	200 & UP
10	62	29	15	10	9	3	0

TEM ASBESTOS ANALYSIS

EMS Lab No. T-1861
Sample Description L2980-091289-SJ-016
Client CC Johnson + Malhotra
Method of Analysis: AHERA
EPA Yamate Level I, II, III
Lengths (µm) >0.5, ≥1, ≥5, ≥10
PCM Range ≥0.25 µm (w), ≥5µm (l)
Aspect Ratio: 1:3, 1:5
Approved by ________ Date ________

Air, Water, Soil, Wi, Bulk, ________
Volume 3 ml Weight ________ g
Filter Type/Area (mm²): MCE/385, MCN/960
Filter Lot No: ________
Pore Size: 0.45µm, 0.8µm, Other .1µm
G.O. Area (mm²) 0.0066 G.O. to analyze 20/100
Direct Prep ✓ Indirect Prep ________
Ashed area (%) ________ Prepared by CT/BP

Grid: 1,2,3,4 Grid Add. 1A
Microscope [illegible]
Screen Magnification [illegible] X
Camera Constant ________
Accelerating Voltage KV 100
Beam Current µA [illegible]
Analyst [illegible]
Date 9/14/89

Grid Opening	Structure Number	Structure	Dimension (mm) Width	Length	Diameter	SAED Observation Chrysotile	Amphibole	Ambiguous	Non Asbestos	No Pattern	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
1		F	1	10						✓							
		F	2	12					✓								
		F	1	10						✓							
		F	1	11		✓											
		F	1.5	20		✓											
		F	1	18		✓											
		F	1	22		✓											
		F	1	60						✓							
		F	1	15						✓							
		F	1	24						✓							
		F	1	23		✓											
		F	1	9		✓											
		F	1	27		✓											
		F	1	14		✓											
		F	1	30		✓											
		F	1.5	14		✓											
		F	1	26						✓							
		F	1.5	17		✓											
		F	1	14		✓											
2		F	1	11													

Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy

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TEM ASBESTOS ANALYSIS

EMS Lab No. T-1861
Sample Description L2980-091289-SJ-016
Client CC Johnson + Malhotra
Method of Analysis: AHERA
EPA Yamate Level I, II, III
Lengths (µm) >0.5, ≥1, ≥5, ≥10
PCM Range ≥0.25 µm (w), ≥5µm (l)
Aspect Ratio: 1:3, 1:5
Approved by ________ Date ________

Air, Water, Soil, Wi, Bulk, ________
Volume 3 ml Weight ________ g
Filter Type/Area (mm²): MCE/385, MCN/960
Filter Lot No: ________
Pore Size: 0.45µm, 0.8µm, Other .1µm
G.O. Area (mm²) 0.0066 G.O. to analyze 20/100
Direct Prep ✓ Indirect Prep ________
Ashed area (%) ________ Prepared by CT/BP

Grid: 1,2,3,4 Grid Add 1A
Microscope HU-11
Screen Magnification 20000 X
Camera Constant ________
Accelerating Voltage KV 100
Beam Current µA 20
Analyst ________
Date 9/14/89

Grid Opening	Structure Number	Structure	Width	Length	Diameter	Chrysotile	Amosite	Anthophyllite	Non Asbestos	No Pattern	Na	Mg	Si	Ca	Fe	Id	Comments
2		F	1	16		✓											
		F	1	26		✓											
		F	1.5	10		✓											
		F	1	38		✓											
		F	2	24		✓											
		F	1.5	30		✓											
		F	1	12						✓							
		F	1	40		✓											
		F	1.5	20		✓											
		F	1	25						✓							
		F	1	32		✓											
		F	2	42		✓											
		F	1	18						✓							
		F	2	28		✓											
		F	1	15		✓											
		F	1	27						✓							
		F	3	65		✓											
		F	1	38						✓							
3		F	2	20					✓								
		F	1.5	12		✓											

Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy

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EMS No. T-1861

Sample Description L2980-091289-SJ-016

Client CC Johnson + Malhotra

Method of Analysis: AHERA

EPA Yamate Level I, II, III

Lengths (µm) >0.5, ≥1, ≥5, ≥10

PCM Range ≥0.25 µm (w), ≥5µm (l)

Aspect Ratio: 1:3, 1:5

Approved by ________ Date ________

Air, Water, Soil, W ulk, ________

Volume 3 ml ight ________ g

Filter Type/Area (mm²): MCE/385, MCN/960

Filter Lot No: ________

Pore Size: 0.45µm, 0.8µm, Other .1µm

G.O. Area (mm²) 0.0066 G.O. to analyze 20/100

Direct Prep ✓ Indirect Prep ________

Ashed area (%) ________ Prepared by CT/BP

Grid: 1,2,3,4 Grid Add 1A

Microscope HU

Screen Magnification 20000 X

Camera Constant ________

Accelerating Voltage KV 100

Beam Current µA 20

Analyst Emma G

Date 9/14/89

Grid Opening	Structure Number	Structure	Dimension (mm) Width	Length	Diameter	SAED Observation Chrysotile	Amphibole	Ambiguous	Non Asbestos	No Pattern	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
3		F	1	15		✓											
		F	1	40		✓											
		F	1	25		✓											
		F	1	24					✓								
		F	1	21						✓							
		F	1	12						✓							
		F	1	32						✓							
		F	2	21		✓											
		F	2	28		✓											
		F	0.5	95						✓							
		F	1	24		✓											
		F	1	17		✓											
		F	1	21		✓											
		F	1	18		✓											

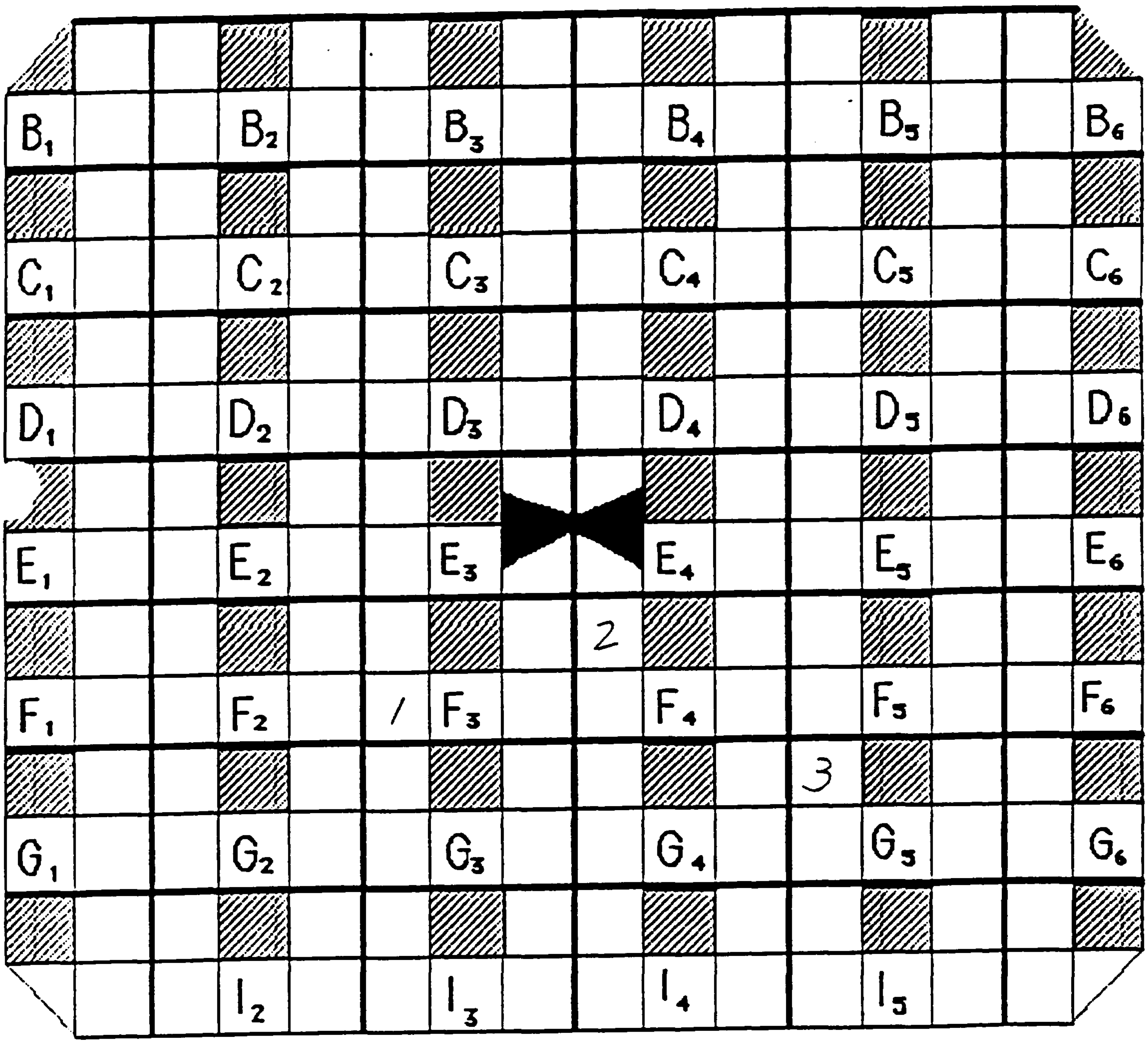
Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy

EMS No -1861

Sample ID L2980-091289-SJ-016

Grid No 4 CE

Microscopist Gumer G.



TEM ASBESTOS ANALYSIS

EMS Lab No. T-1861

Sample Description L2980-091289-SJ-016

Client CC Johnson + Malhotra

Method of Analysis: AHERA

EPA Yamate Level I, II, III

Lengths (µm) >0.5, ≥1, ≥5, ≥10

PCM Range ≥0.25 µm (w), ≥5µm (l)

Aspect Ratio: 1:3, 1:5

Approved by ________ Date ________

Air, Water, Soil, Wipe, Bulk, ________

Volume 3 ml Weight ________ g

Filter Type/Area (mm²): MCE/385, MCN/960

Filter Lot No: ________

Pore Size: 0.45µm, 0.8µm, Other .1µm

G.O. Area (mm²) 0.0066 G.O. to analyze 20/100

Direct Prep ✓ Indirect Prep ________

Ashed area (%) ________ Prepared by CT/BP

Grid: 1,2,3,4 Grid Addr. B

Microscope H600

Screen Magnification 19,000 X

Camera Constant 19.7

Accelerating Voltage KV 100

Beam Current µA 10

Analyst GA

Date 9-14-89

Grid Opening	Structure Number	Structure	Width	Length	Diameter	Chrysotile	Amosite	Amphibole	Non Asbestos	No Pattern	Na	Mg	Si	Ca	Fe	Id	Comments
1	01	F	1	9	/	–											
	02	F	1	100	/	–											
	03	F	1	20	/	–											
	04	F	1	11	/	–											
	05	F	1	32	/	–											
	06	F	1	50	/	–											
	07	F	1	15	/	–											
	08	F	1	15	/	–											
	09	F	1	17	/	–											
	10	F	1	18	/	–											
	11	F	1	18	/	–											
	12	F	1	12	/	–											
	13	F	1	14	/	–											
	14	F	1	19	/	–											
	15	F	1	70	/	–											
	16	F	.5	38	/	–											
	17	F	1	37	/	–											
	18	F	1	20	/	–											
	19	F	1	10	/	–											
	20	F	1	30	/	–											

Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy

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TEM ASBESTOS ANALYSIS

EMS LABORATORIES 507 Mission Street / South Pasadena, CA 91030-3035 / 818-441-2

EMS Lab No. T-1811
Sample Description 4-2920 -091289-ST-016
Client C.C. Schaefer
Method of Analysis: AHERA
EPA Yamate Level I, II, III
Lengths (µm) >0.5, ≥1, ≥5, ≥10
PCM Range ≥0.25 µm (w), ≥5µm (1)
Aspect Ratio: 1:3, 1:5
Approved by ________ Date ________

Air, Water, Soil, Wipe, Bulk, ________
Volume 3 ml 1 Weight ________ g
Filter Type/Area (mm²): MCE/385, MCN/960
Filter Lot No: ________
Pore Size: 0.45µm, 0.8µm, Other 0.1µm
G.O. Area (mm²) 0.0066 G.O. to analyze 20/100
Direct Prep ________ Indirect Prep ________
Ashed area (%) ________ Prepared by ST-BP

Grid: 1,2,3,4 Grid Address ________
Microscope Hitachi
Screen Magnification 19,000 X
Camera Constant 27.7
Accelerating Voltage KV 100
Beam Current µA 10
Analyst CA
Date 9-14-89

Grid Opening	Structure Number	Structure	Width	Length	Diameter	Chrysotile	Amosite	Actinolite	Non Asbestos	No Pattern	Na	Mg	Si	Ca	Fe	Id	Comments
1.0	21	F	1	18	—	—											
	22	F	1	20	—	—											
	23	F	1	27		—											
2	24	F	1	68	—	—											
	25	F	1	15	—	—											
	26	B/N	1	35	—	—											
	27	F	1	10	—	—											
	28	F	1	15	—	—											
	29	F	1	15	—	—											
	30	F	1	29	—	—											
	31	B	1	46	—	—											
	32	F	1	10	—	—											
	33	MD	1	25	—	—											
	34	MD	1	18	—	—											
	35	MD	1	14	—	—											
	36	MD	1	20	—	—											
	37	F	1	22	—	—											
	38	F	1	80	—	—											
	39	F	1	53	—	—											
	40	B	1	76	—	—											

Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy
Other:

EMS Lab No. T-1861
Sample Description L2980-091289-SJ-016
Client CC Johnson + Malhotra
Method of Analysis: AHERA
EPA Yamate Level I, II, III
Lengths (µm) >0.5, ≥1, ≥5, ≥10
PCM Range ≥0.25 µm (w), ≥5µm (l)
Aspect Ratio: 1:3, 1:5
Approved by ________ Date ________

Air, Water, Soil, Wipe, Bulk, ________
Volume 3 ml Weight ________ g
Filter Type/Area (mm²): MCE/385, MCN/960
Filter Lot No: ________
Pore Size: 0.45µm, 0.8µm, Other .1µm
G.O. Area (mm²) 0.0066 G.O. to analyze 20/100
Direct Prep ✓ Indirect Prep ________
Ashed area (%) ________ Prepared by CT/BP

Grid: 1,2,3,4 Grid Add 1B
Microscope HU-4 ...
Screen Magnification ~~20000~~ X 19,200
Camera Constant 99.7
Accelerating Voltage KV 100
Beam Current µA 20
Analyst Emma G GA
Date 9/14/89

Grid Opening	Structure Number	Structure	Width	Length	Diameter	Chrysotile	Amosite	Anthophyllite	Non Asbestos	No Pattern	Na	Mg	Si	Ca	Fe	Id	Comments
5	41	F	1	40	X	✓											
	42	F	1	15		✓											
	43	F	1	10		✓											
	44	F	1	10		✓											
	45	F	1	18		✓											
	46	F	1	19		✓											
	47	MD	1	30		✓											
	48	F	1	12		✓											
	49	F	1	20		✓											
	50	F	1	37		✓											

Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy

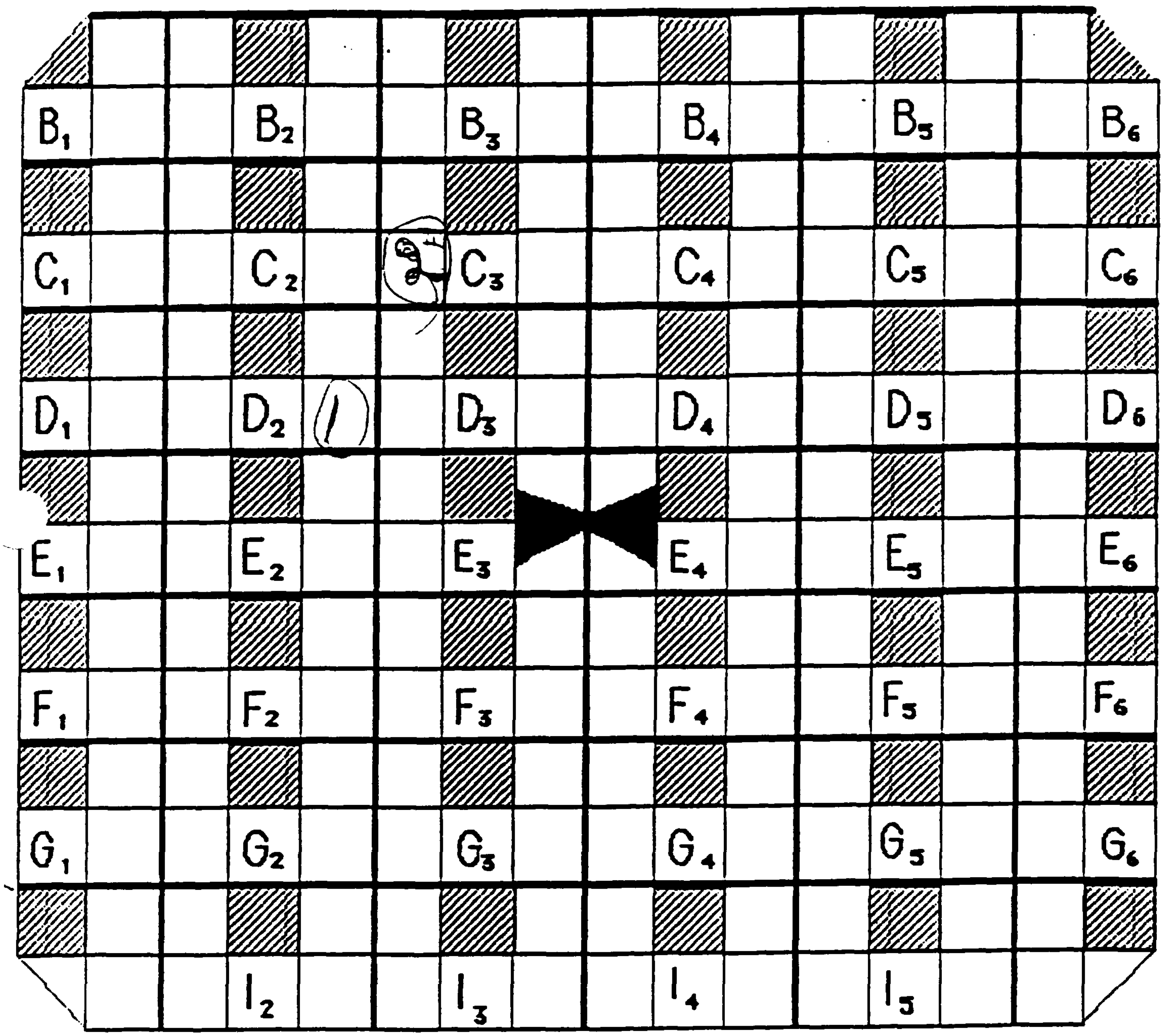
EMS LABORATORIES 507 Mission Street / South Pasadena, CA 91030-3035 / 818-441

EMS No T-1061

Sample ID L2980-091289-5J-C6

Grid No 1-B

Microscopist GA



TEM ASBESTOS A 'ALYSIS

EMS LABORATORIES 507 Mission Street / South Pasadena, CA 91030-3035 / 818-441-

EMS Lab No. T-1861
Sample Description L2980-C9128-S-0 16
C.C. Johnson
Client
Method of Analysis: AHERA
EPA Yamate Level I, II, III
Lengths (µm) >0.5, ≥1, ≥5, ≥10
PCM Range ≥0.25 µm (w), ≥5µm (l)
Aspect Ratio: 1:3, 1:5
Approved by ________ Date ________

Air, Water, Soil, Wipe, Bulk, ________
Volume ________ l Weight ________ g
Filter Type/Area (mm²): MCE/385, MCN/960 ________
Filter Lot No: ________
Pore Size: 0.45µm, 0.8µm, Other ________
G.O. Area (mm²) 0.0________ G.O. to analyze ________
Direct Prep ________ Indirect Prep ________
Ashed area (%)________ Prepared by ________

Grid: 1,2,3,4 Grid Address L-
Microscope PI 600B
Screen Magnification 19,200 X
Camera Constant 27.7
Accelerating Voltage KV 100
Beam Current µA 20
Analyst Radlatigh
Date 9/15/

Grid Opening	Structure Number	Structure	Width	Length	Diameter	Chrysotile	Amphibole	Ambiguous	Non Asbestos	No Pattern	Na	Mg	Si	Ca	Fe	Id	Comments
1			1	22						✓							
			1	20		✓											
			1	18		✓											
			1	30		✓											
			1	11		✓											
			1	22		✓											
			1.5	45		✓											
			1.5	18						✓							
			1	75		✓											
			1	90		✓											
			1	22		✓											
			1	18		✓											
2			1	15		✓											
			1	55		✓											
			1	40		✓											
			1	11		✓											
			1	9		✓											
			1	10		✓											
			1	12		✓											
			1	8		✓											

Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy

TEM ASBESTOS A'ALYSIS

EMS Lab No. T-1861
Sample Description L248-541284-SJ
c 016
Client C. C. Johnson
Method of Analysis: AHERA
EPA Yamate Level I, II, III
Lengths (µm) >0.5, ≥1, ≥5, ≥10
PCM Range ≥0.25 µm (w), ≥5µm (l)
Aspect Ratio: 1:3, 1:5
Approved by ________ Date ________

Air, Water, Soil, Wipe, Bulk, ________
Volume ________ l Weight ________ g
Filter Type/Area (mm²): MCE/385, MCN/960 ____
Filter Lot No: ________
Pore Size: 0.45µm, 0.8µm, Other ________
G.O. Area (mm²) 0.0______ G.O. to analyze ____
Direct Prep ______ Indirect Prep ______
Ashed area (%)______ Prepared by ______

Grid: 1,2,3,4 Grid Address 1
Microscope H Cwb
Screen Magnification 19,200 X
Camera Constant 27.7
Accelerating Voltage KV 100
Beam Current µA
Analyst Radla Siyh
Date 9/15

Grid Opening	Structure Number	Structure	Dimension (mm) Width	Length	Diameter	SAED Observation Chrysotile	Amphibole	Anthophyllite	Non Asbestos	No Pattern	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
1			1	55		✓											
			1	11		✓											
			1	25		✓											
			1	12		✓											
			1	25		✓											
			1	18		✓											
			1	25					✓								
			1	14		✓											
			1	18		✓											
			1	11		✓											
			1	48		✓											
			1	12		✓											
			1	14					✓								
			1	22		✓											
			1	8		✓											
			1	24		✓											
			1	38		✓											
			1	9		✓											
			1	15		✓											
			1	30						✓							

Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy
Other:

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TEM ASBESTOS A ALYSIS

EMS EMS LABORATORIES 507 Mission Street / South Pasadena, CA 91030-3035 / 818-441

EMS Lab No. ____________
Sample Description ____________
Client ____________
Method of Analysis: AHERA
EPA Yamate Level I, II, III
Lengths (µm) >0.5, ≥1, ≥5, ≥10
PCM Range ≥0.25 µm (w), ≥5µm (l)
Aspect Ratio: 1:3, 1:5
Approved by ________ Date ________

Air, Water, Soil, Wipe, Bulk, ____________
Volume ________ l Weight ________ g
Filter Type/Area (mm²): MCE/385, MCN/960 ______
Filter Lot No: ____________
Pore Size: 0.45µm, 0.8µm, Other ______
G.O. Area (mm²) 0.0______ G.O. to analyze ____
Direct Prep ______ Indirect Prep ______
Ashed area (%)______ Prepared by ______

Grid: 1,2,3,4 Grid Address ______
Microscope ____________
Screen Magnification ________ X
Camera Constant ________
Accelerating Voltage KV 100
Beam Current µA ________
Analyst ________
Date ________

Grid Opening	Structure Number	Structure	Dimension (mm) Width	Length	Diameter	SAED Observation Chrysotile	Amphibole	Ambiguous	Non Asbestos	No Pattern	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
2			1	22		✓											
			1	18		✓											
			1	22		✓											
			1	45		✓											
			1	18		✓											
			1	14					✓								
			1	18		✓											
			1	22		✓											
			1	24		✓											
			1	14						✓							
			1	38		✓											
			1	30		✓											
			1	35		✓											
			1	12		✓											
			1	18		✓											
			1	44		✓											
			1	42		✓											
		+	2	18		✓											
			1	11		✓											
			1	9					✓								

Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy

TEM ASBESTOS ANALYSIS

EMS Lab No. 1861
Sample Description L2980-091289-SJ-016
Client
Method of Analysis: AHERA
EPA Yamate Level I, II, III
Lengths (μm) >0.5, ≥1, ≥5, ≥10
PCM Range ≥0.25 μm (w), ≥5μm (l)
Aspect Ratio: 1:3, 1:5
Approved by ________ Date ________

Air, Water, Soil, Wipe, Bulk, ________
Volume ________ l Weight ________ g
Filter Type/Area (mm^2): MCE/385, MCN/960 ____
Filter Lot No: ________
Pore Size: 0.45μm, 0.8μm, Other ________
G.O. Area (mm^2) 0.0 ______ G.O. to analyze ____
Direct Prep ______ Indirect Prep ________
Ashed area (%) ______ Prepared by ________

Grid: 1,2,3,4 Grid Address ____
Microscope ________
Screen Magnification ________ X
Camera Constant ________
Accelerating Voltage KV 100
Beam Current μA ________
Analyst ________
Date ________

Grid /Opening	Structure Number	Structure	Dimension (mm) Width	Length	Diameter	SAED Observation Chrysotile	Amphibole	Ambiguous	Non Asbestos	No Pattern	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
2			1	24					✓								
			1	44		✓											

Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy
Other:

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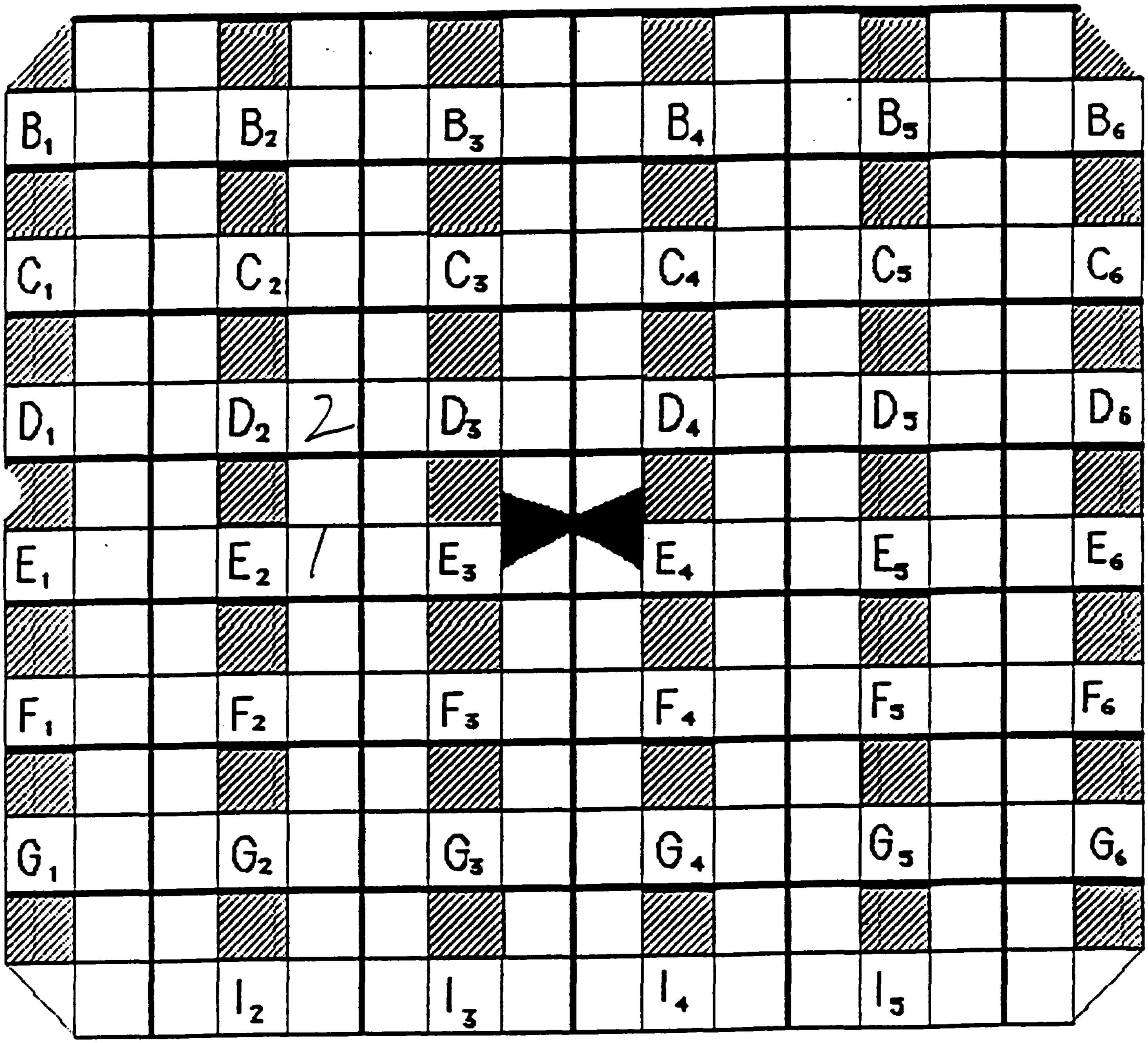
EMS No I 1861

Sample ID

Grid No 1-C

Microscopist Radka Singh.



Analysis of V er by Transmission Electron roscopy
(EPA-600/4-80-005)

1S No.	T-1861	Date	9/15/89
		Reference	M-W
Client	C.CJOHNSON &MALHOTRA		
Sample No.	EMS BLANK		

Fibers (chrysotile)	ND	MFL
> 5 Micron length (chrysotile)	ND	MFL
Mass (chrysotile)	0	ug/L
More/Less than 5 Fibers in Sample (chrysotile)	LESS	
Sensitivity Level	0.04	MFL

Particle Size Distribution (Chrysotile)

Particle Length - Microns

O -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 & UP
0	0	0	0	0	0

Particle Width - Microns

O - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 & UP
0	0	0	0	0	0

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 & UP
0	0	0	0	0	0

TEM ASBESTOS NALYSIS

EMS Lab No. T-1861
Sample Description Ems Blank
Client CC Johnson + Malhotra
Method of Analysis: AHERA
EPA Yamate Level I, II, III
Lengths (µm) >0.5, ≥1, ≥5, ≥10
PCM Range ≥0.25 µm (w), ≥5µm (l)
Aspect Ratio: 1:3, 1:5
Approved by ________ Date ________

Air, Water, Soil, Wipe, Bulk, ________
Volume 200 ml Weight ________ g
Filter Type/Area (mm²): MCE/385, MCN/960
Filter Lot No: ________
Pore Size: 0.45µm, 0.8µm, Other .1µm
G.O. Area (mm²) 0.0046 G.O. to analyze 20
Direct Prep ✓ Indirect Prep ________
Ashed area (%) ________ Prepared by CT/BP

Grid: 1,2,3,4 Grid Address ________
Microscope ___ - 11E
Screen Magnification 20K X
Camera Constant ________
Accelerating Voltage KV 100/5
Beam Current µA 20
Analyst KK
Date 9/14/89

Grid Opening	Structure Number	Structure	Dimension (mm) Width	Length	Diameter	SAED Observation Chrysotile	Amphibole	Ambiguous	Non Asbestos	No Pattern	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
1	NS	D															
2	NS	D															
3	NS	D															
4	NS	D															
5	NS	D															
6	NS	D															
7	NS	D															

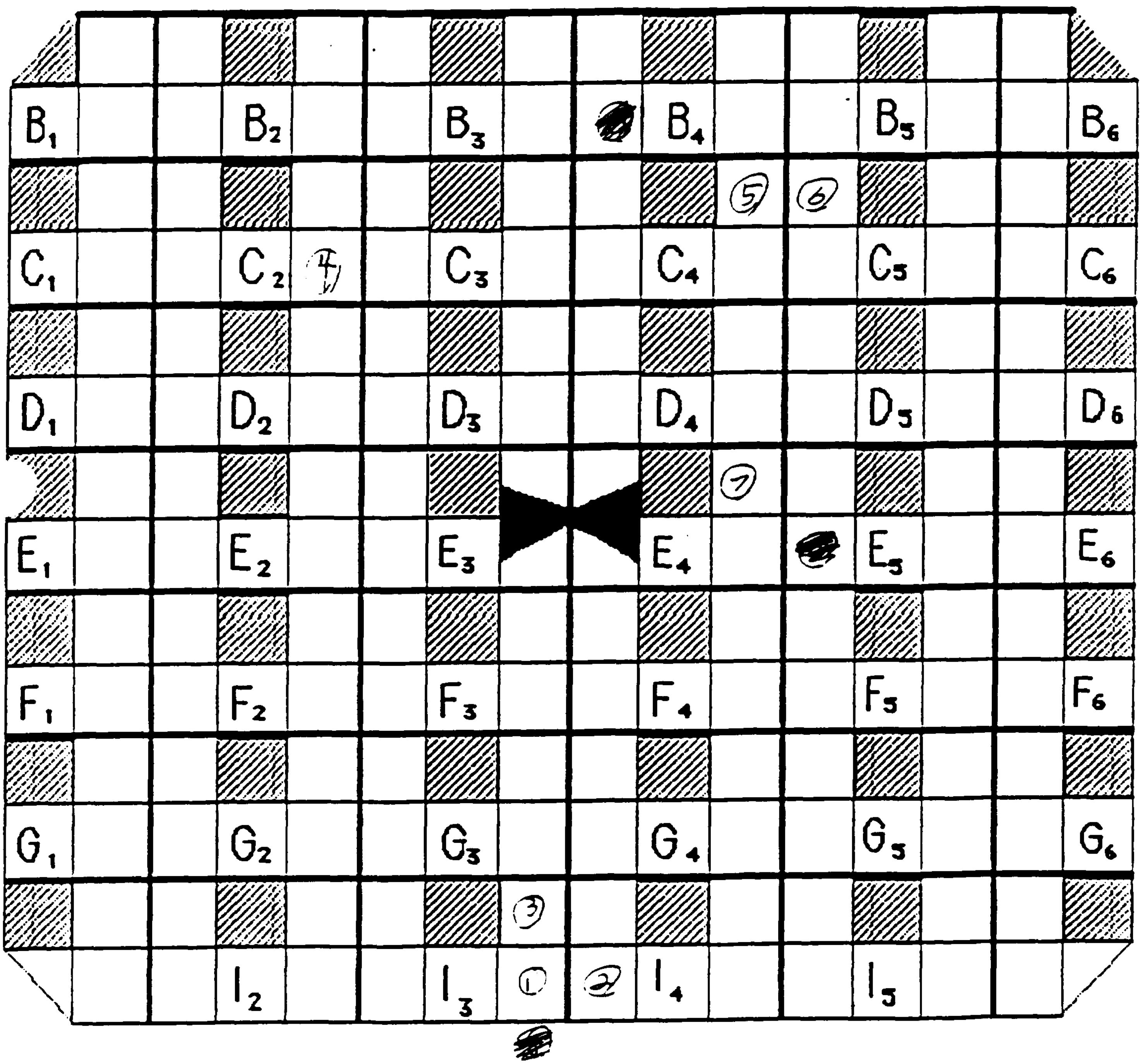
Observations: 1. Clean 2. Debris: very light, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy

EMS No T-1 ,1

Sample ID EHS Blank

Grid No 1-1A

Microscopist KK



TEM ASBESTOS ANALYSIS

EMS LABORATORIES 307 Mission Street / South Pasadena, CA 91030-3035 / 818-44

EMS Lab No. T-1861
Sample Description EMS Blank
Client CC Johnson + Malhotra
Method of Analysis: AHERA
EPA Yamate Level I, II, III
Lengths (μm) >0.5, ≥1, ≥5, ≥10
PCM Range ≥0.25 μm (w), ≥5μm (l)
Aspect Ratio: 1:3, 1:5
Approved by ______ Date ______

Air, Water, Soil, Wip, Bulk, ______
Volume 200 ml Weight ______ g
Filter Type/Area (mm²): MCE/385, MCN/960
Filter Lot No: ______
Pore Size: 0.45μm, 0.8μm, Other .1μm
G.O. Area (mm²) 0.0046 G.O. to analyze 20
Direct Prep ✓ Indirect Prep ______
Ashed area (%) ______ Prepared by CT/BP

Grid: 1,2,3,4 Grid Add B
Microscope HU-11C
Screen Magnification 20K X
Camera Constant ______
Accelerating Voltage KV ~~100~~ 75
Beam Current μA 20
Analyst Y.K
Date 9/15/89

Grid Opening	Structure Number	Structure	Dimension (mm) Width	Length	Diameter	SAED Observation Chrysotile	Amphibole	Ambiguous	Non Asbestos	No Pattern	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
1	NS	D															
2	NS	D															
3	NS	D															
4	NS	D															
5	NS	D															
6	NS	D															
7	NS	D															
8	NS	D															
9	NS	D															
10	NS	D															
11	NS	D															
12	NS	D															
13	NS	D															

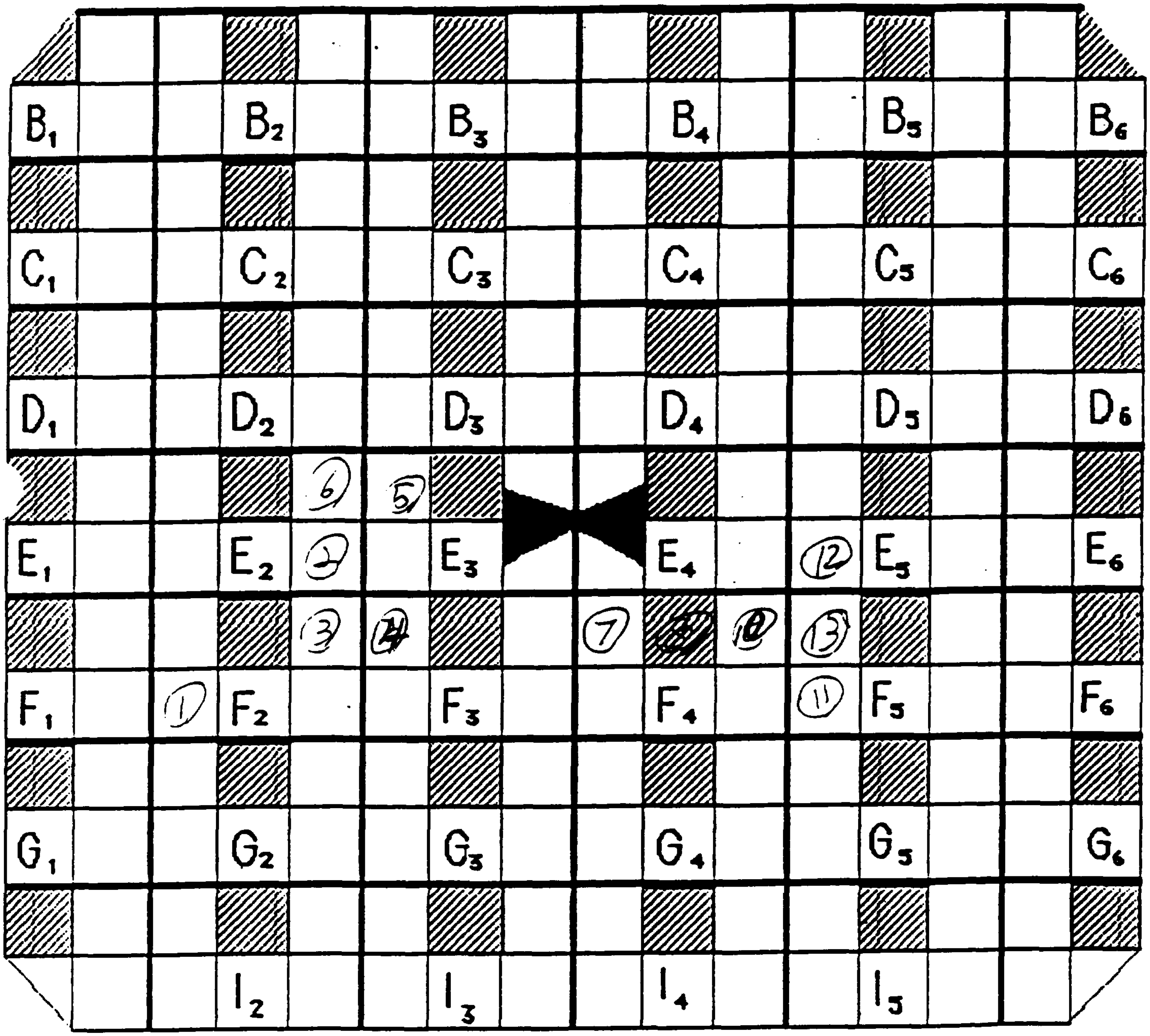
Observations: 1. Clean 2. Debris: ~~very light~~, light, moderate, moderate-heavy, heavy, very heavy 3. Gypsum: light, heavy

EMS No T 861

Sample ID EMS Blank

Grid No 1-1B

Microscopist KK



APPENDIX N

MISCELLANEOUS BULK AND SOIL SAMPLE DATA

PARTICLE DATA LABORATORIES, LTD.

115 Hahn Street • Elmhurst, Illinois 60126 • (312) 832-5658

August 25, 1989

Mr. David Dempsey
Conestoga-Rovers & Associates Inc.
10400 W. Higgins Road
Rosemont, Illinois 60018

RE: Examination of Bulk Samples for Asbestos
P.O. Number: 2980
Location: Manville Remediation
PDL Project: 15639
EPA Lab I.D. Number 5118

Dear Mr. Dempsey:

The following report consists of asbestos identification by polarized light microscopy of the samples received 8-14-89.

The samples were not collected by Particle Data personnel.

It has been a pleasure serving you, and we look forward to serving you again in the near future. If you have any questions concerning this report, please do not hesitate to call us at Particle Data Laboratories, Ltd.

Respectfully submitted,

PARTICLE DATA LABORATORIES, LTD.

Ron Sturm / JTA

Ron Sturm

Microscopist

ENCLOSURES

PARTICLE DATA LABORATORIES, LTD.

The attached information tabulates the quantities of fibrous material found in each sample; the numbers will not necessarily add up to 100%, with the balance being filler and binder materials. When a sample is labeled as inhomogeneous, there is the possibility of significantly higher local concentrations than the averaged value reported. This could result in local high airborne asbestos fiber levels if the material is disturbed and appropriate safety precautions are indicated. Also, the symbol (-) indicates not detected.

Identification and quantifications were performed in accordance with Appendix A - Interim Method for the Determination of Asbestos in Bulk Insulation Samples of EPA Asbestos in Schools Regulations, Federal Register, Vol. 47, No. 103, Thursday, May 27, 1982. Analysis was initiated by a gross examination of the sample as received. Any obvious fractions were noted and samples of each fraction were mounted for polarized light microscopy in a 1.515 index liquid. When mounting samples any fiberous material is thoroughly separated for examination. Preliminary evaluation to determine the possible species of asbestos present is performed by morphology, birefringence and refractive index relative to the mounting fluid. Concurrently the relative abundance of any asbestos material, other fibers, fillers and binders is determined. Quantities are based on areal coverage and thickness of the various species present. The term trace means 0.1% or less. Identification of non-asbestos material is not as rigorous as these are not the species of interest.

When asbestos type fibers are seen morphologically, they are additionally characterized by immersion matching in refractive index liquid using both white light and sodium d-line. A numeric determination of birefringence is available based on the index measurments. A sample has to fit into the accepted ranges of indices, birefringence and morphological features to be classed as asbestos.

The features of the various forms of asbestos are as follows:

Amosite: Straight thin single fibers and bundles of such fibers usually with cleanly broken ends on individual fibers; refractive indices of 1.700 and 1.695, birefringence 0.020-0.033 and parallel extinctions.

Chrysotile: Thin fibers and fiber bundles with both straight and wavy sections. The ends of bundles tend to be frayed. Indices are 1.529-1.559 and 1.537-1.576, birefringence of 0.004-0.016 and the fibers exhibit parallel extinction.

Asbestos Forms Continued:

Anthophylite: Similar in morphology to amosite but indices of 1.60-1.64, birefrigence of 0.013 -0.025 and extinction varying from parallel to 15 degrees oblique.

Crocidolite: Similar in morphology to amosite but is distinguished by blue to blue-green pleochroic coloration and indices of 1.680-1.698 and 1.685-1.706. It is commonly referred to as blue asbestos.

Tremolite-Actinolite Series: Transparent, elongated furrowed prisms, usually with uneven, jagged ends and smooth sides, with oblique extinction and positive elongation; indices are 1.559-1.612 and 1.625-1.637. The two minerals are very similar optically and grade into each other.

"Friable material" means any material applied onto ceilings, walls, structural members, piping, ductwork or any other part of the building structure which, when dry, may be crumbled, pulverized or reduced to powder by hand pressure.

Attached are representative photomicrographs of each sample and a compendium of the materials found. The micrographs are taken with crossed polars and a first order red compensator which results in the pink background and shows birefringence as bright colors other than the background and isotropic transparent material as the same color as the background.

Sample(s) will be retained for six months unless otherwise instructed.

DETERMINATION OF ASBESTOS IN SOIL SAMPLES VIA PLM

Included in the group of samples presented to Particle Data Laboratories for asbestos analysis are soil samples. Soil samples are not analyzed in the same manner as normal bulk insulation samples. The following is a brief description of the methods and deviations necessary for the analysis of these types of samples.

Purpose and Restrictions - Polarized light microscopy (PLM) is a relatively quick and inexpensive method of determining the identity and quantity of fibrous material in soil samples. It is the standard test method used for evaluating asbestos content in insulation and building materials. PLM techniques work well in determining "gross" contamination of asbestos in soils, but may become unreliable if the asbestos fibers are very fine, generally less than 5 microns. Because of this limitation, and the likelihood that weathering mechanism such as rain and abrasion have caused the breakdown of asbestos fibers into very fine fibrils, the EPA has suggested that soils be analyzed via electron microscopy (EM). Electron microscopy provides higher magnification capabilities and better resolution, but costs may be ten times that of optical techniques. Due to the cost prohibitive nature of many environmental surveys, PLM techniques are used as preliminary indicators of gross contamination, usually followed by electron microscopy work on select samples showing little or no asbestos content. In submitting a soil sample the client further recognizes the limited capabilities of the PLM method.

Analysis - The analysis of a soil sample via polarized light microscopy generally follows the techniques used in the analysis of bulk insulation samples. Presently there is not a government/ agency issued method which directly deals with the analysis of soil samples via polarized light microscopy techniques. The method used at Particle Data Laboratories is structured around the U.S. Environmental Protection Agency's "Interim Method for the Determination of Asbestos in Bulk Insulation Samples," 40 CFR Part 763, Subpart F, Appendix A, 1987. Though this method is designed for the analysis of friable building materials, most of the steps used in this method are included in the analysis of soil samples, with a few deviations.

The soil sample is first examined in the state it has been received, noting the amount of sample received, if the sample is wet or dry, and the homogeneity of the sample. Typically only 100 to 200 grams of soil is necessary for analysis. In the event that more is given, the sample is split, 100 to 200 grams are retained, and the remaining soil is stored, for future EM analysis

or return to client. Care is taken to subdivide the sample correctly. If the sample is heterogeneous, or "non-uniform" in composition, each subcomponent must be represented in proportion in the split. If the sample is wet then the split sample is dried on a heating pad or in an oven. When dried the split portion is broken down and ground to a fine powder using a mortar and pestal.

Any gravel, large stones, or pieces of insulation or building materials are not ground with the soil but still retained in the split and included in the analysis. At this point the sample is ready for preparation.

A soil sample is initially examined macroscopically using a stereomicroscope and probing tools. Estimations of asbestos content, as well as other fibrous components, are recorded in a laboratory workbook and any suspect fibers are picked out of the soil, mounted on a 1"X3" glass slide and immersed in an appropriate refractive index liquid for the determination of refractive indices via dispersion staining or Becke line techniques, and microscopical characterization. If pieces of insulation or building material are found in the soil, large fibers of asbestos may be present and easily identified. However, most soil samples do not contain such material and require gross preparation of the soil. This is done by placing "pinch" quantities of soil in immersion oil on a glass slide, mixing, and capping with a coverslip. Typically, eight to ten 22mm X 22mm preps are made for each sample. From here, the interim method is applied and fibrous component identification and quantification is determined.

The parameters determined for suspect fibers include: anisotropy, sign of elongation, morphology, extinction angles, pleochroism, color and refractive indices, when possible. Magnification factors of 100 to 400X are typically used in soil sample examination. Refer to the Asbestos Characterization section of the main explanation sheets for feature descriptions for the six common asbestos minerals.

Quantification - Quantification of the asbestos materials present in a soil sample are typically estimations based on areal coverage and thickness determinations and are given in volume percents. Due to the possible presence of sub-micron sized asbestos fibers, finer than the resolution limits of the polarized light microscope and thus unseen during analysis, this analysis only is valid for particles larger than 5 microns in size and a minimum detection limit of 1% is established.

Sample Retention - Soil sample analysis is a destructive test. The material prepared on slides are typically saved for two weeks, then disposed of as asbestos trash. However, there is always soil left which is saved for future re-analysis by TEM, if requested. The sample(s) will be retained for six months unless otherwise instructed.

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: Conestoga-Rovers & Associates Inc. Date: August 21, 1989

PDL Project: 15639 Analyst: Ron Sturm

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*----- Cellulose	Fibrous Glass	Other Fibers
7736 B	S2980-081189-SJ-001	Chrysotile/<1 [a] Crocidolite/<1 [a]	1-3	<1	Hair/<1
7737 B	S2980-081189-SJ-002	Chrysotile/<1 [b] Crocidolite/<1 [b]	1-3	<1	Hair/<1 Synthetics/<1
7738 B	S2980-081189-SJ-003	Chrysotile/<1	1-3	<1	--
7739 B	S2980-081189-SJ-004	Chrysotile/<1 [b] Crocidolite/<1 [b]	1-3	<1	--
7740 B	S2980-081189-SJ-005	Chrysotile/<1	1-3	<1	--

a = Combined Asbestos Content $\leq$ 1%. Due to Presence of Bulk Insulation Material in Sample, Local Asbestos Contents may be Higher.

b = Combined Asbestos Content < 1%. Due to Presence of Bulk Insulation Material in Sample, Local Asbestos Content may be Higher.

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: Conestoga-Rovers & Associates Inc. Date: August 21, 1989

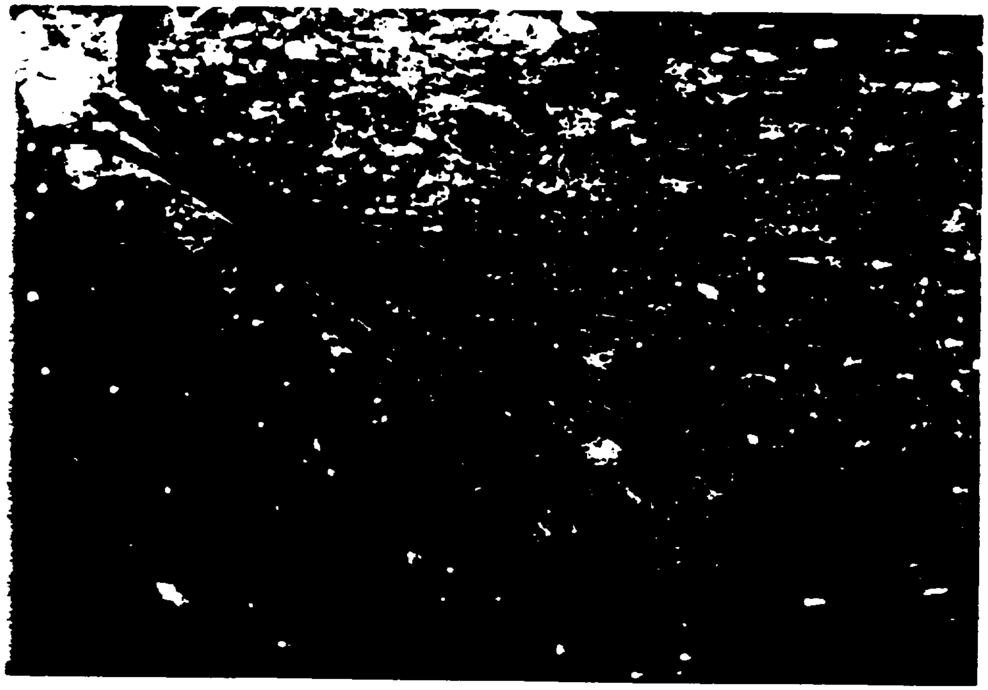
PDL Project: 15637 Analyst: Ron Sturm

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*-----		
			Cellulose	Fibrous Glass	Other Fibers
7741 B	S2980-081189-SJ-006	<1 **	1-3	<1	--[c]
7742 B	S2980-081189-SJ-007	Chrysotile/<1	1-3	<1	--
7743 B	S2980-081189-SJ-008	Chrysotile/<1	1-3	<1	--

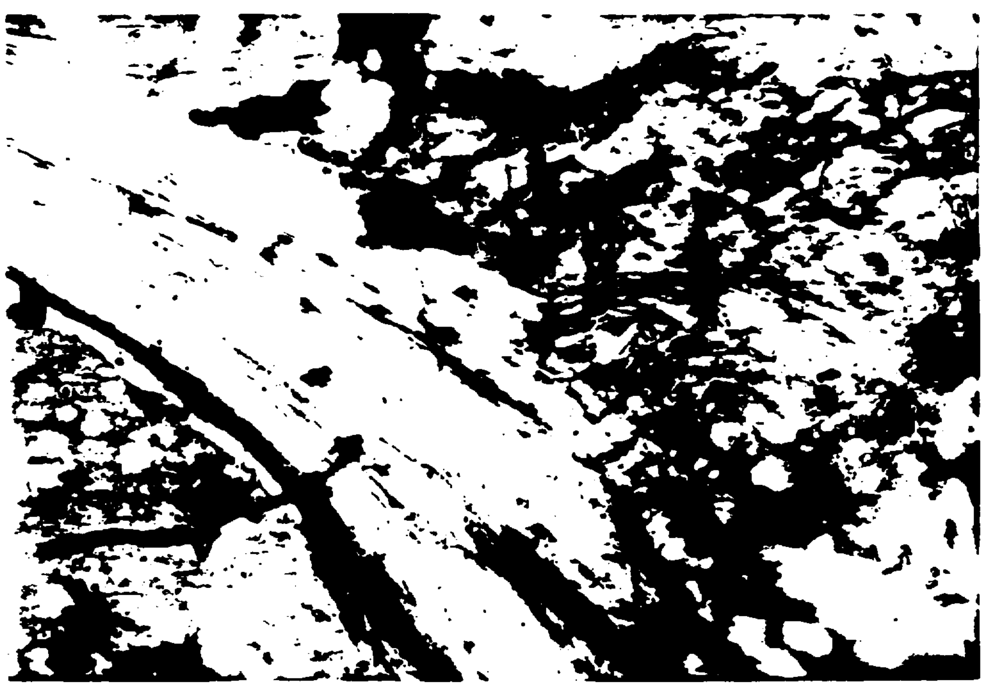
c = Predominant Components of the Sample are Mixed Silicates, Carbonates & Clays. Amphiboles are Present as Cleavage Fragments and Grains, but Fibrous Forms are not Detected.

* = Percent by volume

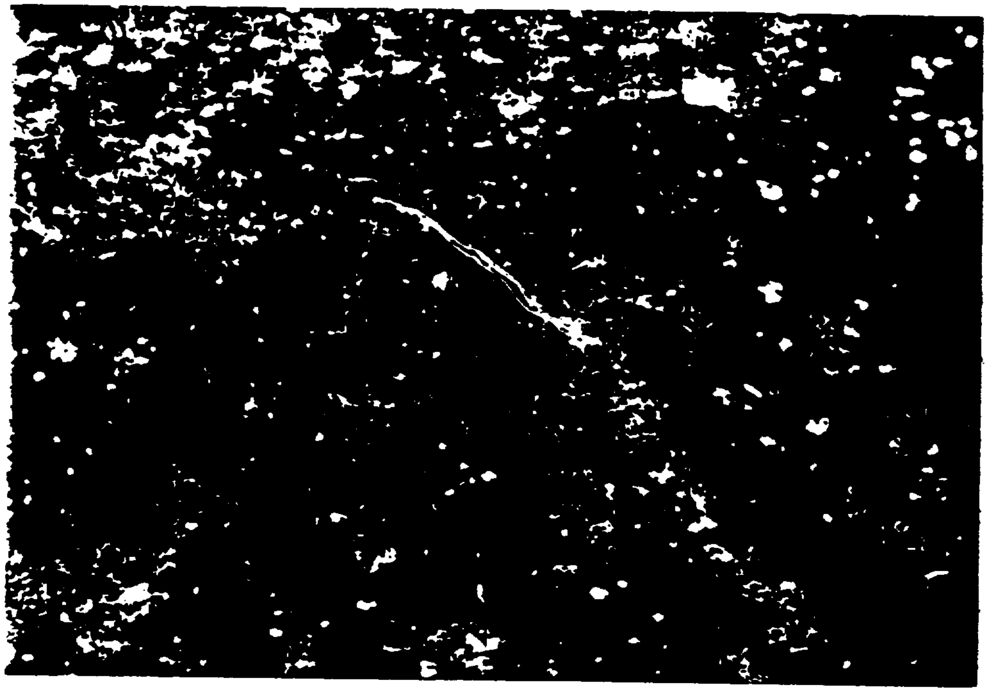
** = No observed asbestos events for particles > 5 microns.



Magnification 100X Sample 7736 B

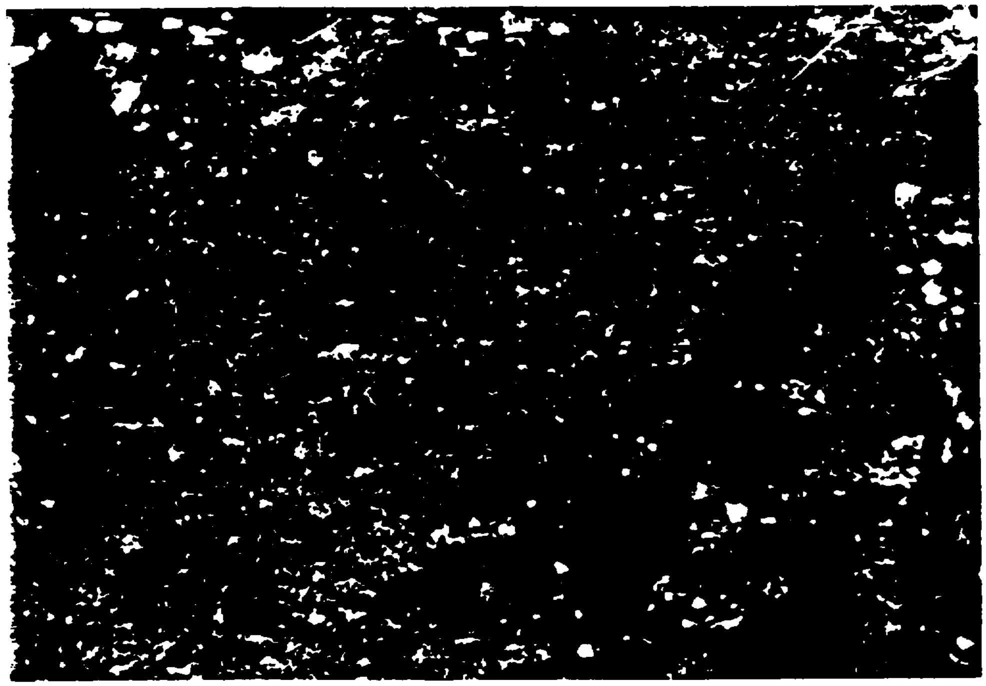


Magnification 100X Sample 7737 B

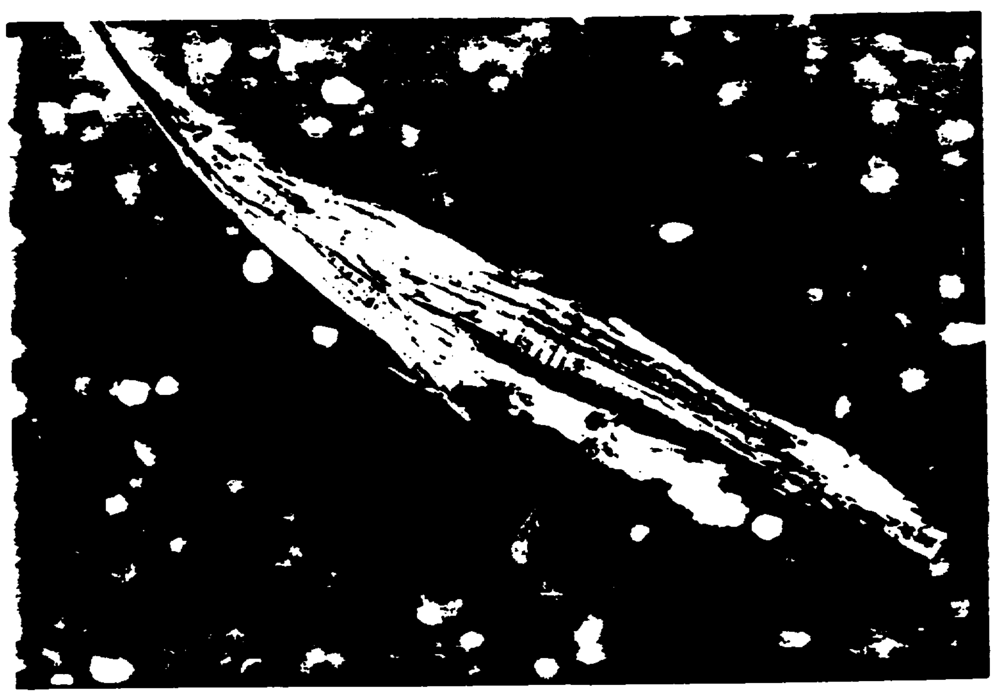


Magnification 100X Sample 7738 B

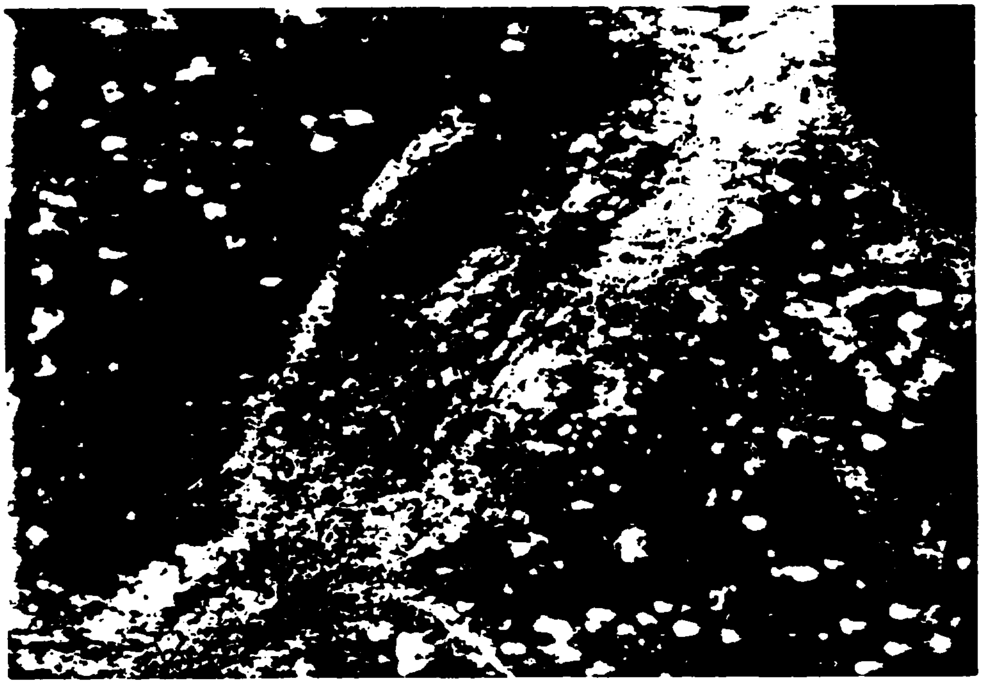
Magnification 100X Sample 7739 B



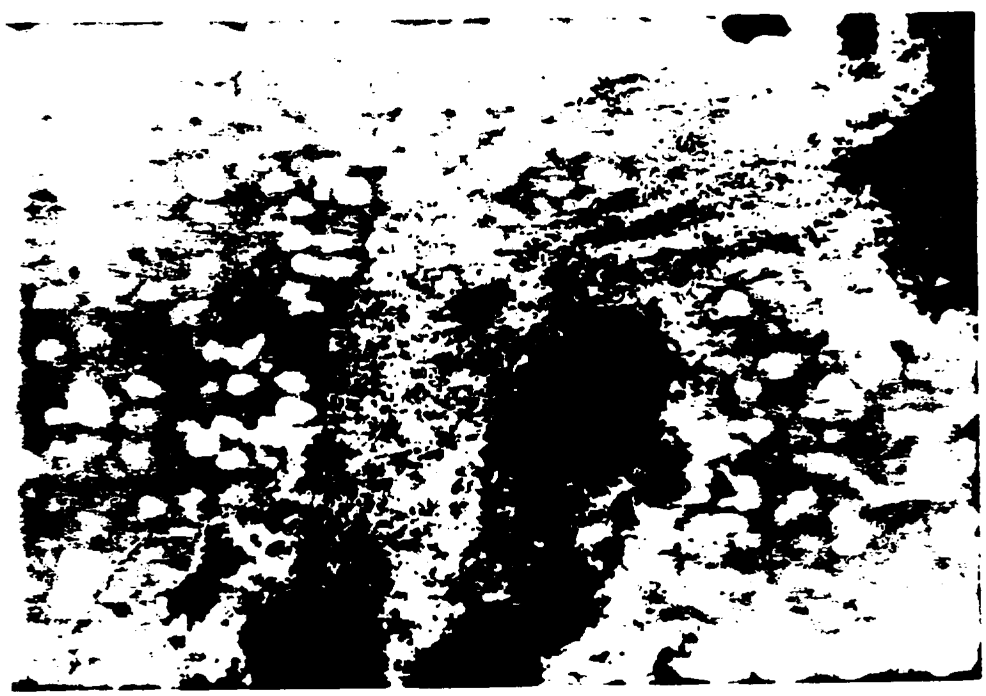
Magnification 100X Sample 7740 B



Magnification 100X Sample 7741 B



Magnification 100X Sample 7742 B



Magnification 100X Sample 7743 B

15639

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): PARTICLE DATA

CHAIN OF CUSTODY RECORD

PROJECT №: 2980

PROJECT NAME: Manville Remediation

SAMPLER'S SIGNATURE (SIGN)

SEQ. №	~~SAMPLE №~~	DATE	TIME	SAMPLE ~~LOCATOIN~~ ID	SAMPLE TYPE	№ OF CONTAINERS	REMARKS
1	—	8-11-89	0928	S2980-081189-SS-001	Soil	1	Asbestos Analysis
2	—		0936	-002	Soil	1	
3	—		0941	-003		1	
4	—		0948	-004		1	
5	—		0953	-005		1	
6	—		0958	-006		1	
7	—		1002	-007		1	
8	—		1006	-008		1	
							2-3 d turnaround requested.
	May	fax	Results	to			
	Sam	Jury	(312) 623-2702				
			TOTAL NUMBER OF CONTAINERS			8	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY: 1 (SIGN)	DATE/TIME 8/11/89	RECEIVED BY: 2 (SIGN)
RELINQUISHED BY: 2 (SIGN)	DATE/TIME 8/14/89	RECEIVED BY: 3 (SIGN)
RELINQUISHED BY: 3 (SIGN)	DATE/TIME	RECEIVED BY: 4 (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT:	SHIPPED BY:	RECEIVED FOR LABORATORY BY:	DATE/TIME
Car	D Dempsey	(SIGN) Carol Litson	8/14/89 11:30 AM

CONDITION OF SEAL UPON RECEIPT:
GENERAL CONDITION OF COOLER:

COOLER OPENED BY: (SIGN)

DATE/TIME

WHITE - CRA OFFICE COPY
YELLOW - RECEIVING LABORATORY COPY
PINK - CRA LABORATORY COPY
GOLDEN ROD - SHIPPERS

№ 005948

PARTICLE DATA LABORATORIES, LTD.

Rec'd

1989

115 Hahn Street • Elmhurst, Illinois 60126 • (312) 832-5658

August 28, 1989

Mr. David Dempsey
Conestoga-Rovers & Associates Inc.
10400 W. Higgins Road
Rosemont, Illinois 60018

RE: Examination of Bulk Samples for Asbestos
P.O. Number: 2980
Location: Manville Site Remediation
PDL Project: 15639
EPA Lab I.D. Number 5118

Dear Mr. Dempsey:

The following report consists of asbestos identification by polarized light microscopy of the samples received 8-23-89.

The samples were not collected by Particle Data personnel.

It has been a pleasure serving you, and we look forward to serving you again in the near future. If you have any questions concerning this report, please do not hesitate to call us at Particle Data Laboratories, Ltd.

Respectfully submitted,

PARTICLE DATA LABORATORIES, LTD.

Ron Sturm

Microscopist

ENCLOSURES

PARTICLE DATA LABORATORIES, LTD.

DETERMINATION OF ASBESTOS IN SOIL SAMPLES VIA PLM

Included in the group of samples presented to Particle Data Laboratories for asbestos analysis are soil samples. Soil samples are not analyzed in the same manner as normal bulk insulation samples. The following is a brief description of the methods and deviations necessary for the analysis of these types of samples.

Purpose and Restrictions - Polarized light microscopy (PLM) is a relatively quick and inexpensive method of determining the identity and quantity of fibrous material in soil samples. It is the standard test method used for evaluating asbestos content in insulation and building materials. PLM techniques work well in determining "gross" contamination of asbestos in soils, but may become unreliable if the asbestos fibers are very fine, generally less than 3 microns. Because of this limitation, and the likelihood that weathering mechanism such as rain and abrasion have caused the breakdown of asbestos fibers into very fine fibrils, the EPA has suggested that soils be analyzed via electron microscopy (EM). Electron microscopy provides higher magnification capabilities and better resolution, but costs may be ten times that of optical techniques. Due to the cost prohibitive nature of many environmental surveys, PLM techniques are used as preliminary indicators of gross contamination, usually followed by electron microscopy work on select samples showing little or no asbestos content. In submitting a soil sample the client further recognizes the limited capabilities of the PLM method.

Analysis - The analysis of a soil sample via polarized light microscopy generally follows the techniques used in the analysis of bulk insulation samples. Presently there is not a government/ agency issued method which directly deals with the analysis of soil samples via polarized light microscopy techniques. The method used at Particle Data Laboratories is structured around the U.S. Environmental Protection Agency's "Interim Method for the Determination of Asbestos in Bulk Insulation Samples," 40 CFR Part 763, Subpart F, Appendix A, 1987. Though this method is designed for the analysis of friable building materials, most of the steps used in this method are included in the analysis of soil samples, with a few deviations.

The soil sample is first examined in the state it has been received, noting the amount of sample received, if the sample is wet or dry, and the homogeneity of the sample. Typically only 100 to 200 grams of soil is necessary for analysis. In the event that more is given, the sample is split, 100 to 200 grams are retained, and the remaining soil is stored, for future EM analysis

or return to client. Care is taken to subdivide the sample correctly. If the sample is heterogeneous, or "non-uniform" in composition, each subcomponent must be represented in proportion in the split. If the sample is wet then the split sample is dried on a heating pad or in an oven. When dried the split portion is broken down and ground to a fine powder using a mortar and pestal.

Any gravel, large stones, or pieces of insulation or building materials are not ground with the soil but still retained in the split and included in the analysis. At this point the sample is ready for preparation.

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The parameters determined for suspect fibers include: anisotropy, sign of elongation, morphology, extinction angles, pleochroism, color and refractive indices, when possible. Magnification factors of 100 to 400X are typically used in soil sample examination. Refer to the Asbestos Characterization section of the main explanation sheets for feature descriptions for the six common asbestos minerals.

<u>Quantification</u> - Quantification of the asbestos materials present in a soil sample are typically estimations based on areal coverage and thickness determinations and are given in volume percents. Due to the possible presence of sub-micron sized asbestos fibers, finer than the resolution limits of the polarized light microscope and thus unseen during analysis, this analysis only is valid for particles larger than 5 microns in size and a minimum detection limit of 1% is established.

<u>Sample Retention</u> - Soil sample analysis is a destructive test. The material prepared on slides are typically saved for two weeks, then disposed of as asbestos trash. However, there is always soil left which is saved for future re-analysis by TEM, if requested. The sample(s) will be retained for six months unless otherwise instructed.

PARTICLE DATA LABORATORIES, LTD.

The attached information tabulates the quantities of fibrous material found in each sample; the numbers will not necessarily add up to 100%, with the balance being filler and binder materials. When a sample is labeled as inhomogeneous, there is the possibility of significantly higher local concentrations than the averaged value reported. This could result in local high airborne asbestos fiber levels if the material is disturbed and appropriate safety precautions are indicated. Also, the symbol (-) indicates not detected.

Identification and quantifications were performed in accordance with Appendix A - Interim Method for the Determination of Asbestos in Bulk Insulation Samples of EPA Asbestos in Schools Regulations, Federal Register, Vol. 47, No. 103, Thursday, May 27, 1982. Analysis was initiated by a gross examination of the sample as received. Any obvious fractions were noted and samples of each fraction were mounted for polarized light microscopy in a 1.515 index liquid. When mounting samples any fiberous material is thoroughly separated for examination. Preliminary evaluation to determine the possible species of asbestos present is performed by morphology, birefringence and refractive index relative to the mounting fluid. Concurrently the relative abundance of any asbestos material, other fibers, fillers and binders is determined. Quantities are based on areal coverage and thickness of the various species present. [redacted] <5% Identification of non-asbestos material is not as rigorous as these are not the species of interest.

When asbestos type fibers are seen morphologically, they are additionally characterized by immersion matching in refractive index liquid using both white light and sodium d-line. A numeric determination of birefringence is available based on the index measurments. A sample has to fit into the accepted ranges of indices, birefringence and morphological features to be classed as asbestos.

The features of the various forms of asbestos are as follows:

Amosite: Straight thin single fibers and bundles of such fibers usually with cleanly broken ends on individual fibers; refractive indices of 1.700 and 1.695, birefringence 0.020-0.033 and parallel extinctions.

Chrysotile: Thin fibers and fiber bundles with both straight and wavy sections. The ends of bundles tend to be frayed. Indices are 1.529-1.559 and 1.537-1.576, birefringence of 0.004-0.016 and the fibers exhibit parallel extinction.

Asbestos Forms Continued:

Anthophylite: Similar in morphology to amosite but indices of 1.60-1.64, birefrigence of 0.013 -0.025 and extinction varying from parallel to 15 degrees oblique.

Crocidolite: Similar in morphology to amosite but is distinguished by blue to blue-green pleochroic coloration and indices of 1.680-1.698 and 1.685-1.706. It is commonly referred to as blue asbestos.

Tremolite-Actinolite Series: Transparent, elongated furrowed prisms, usually with uneven, jagged ends and smooth sides, with oblique extinction and positive elongation; indices are 1.559-1.612 and 1.625-1.637. The two minerals are very similar optically and grade into each other.

"Friable material" means any material applied onto ceilings, walls, structural members, piping, ductwork or any other part of the building structure which, when dry, may be crumbled, pulverized or reduced to powder by hand pressure.

Attached are representative photomicrographs of each sample and a compendium of the materials found. The micrographs are taken with crossed polars and a first order red compensator which results in the pink background and shows birefringence as bright colors other than the background and isotropic transparent material as the same color as the background.

Sample(s) will be retained for six months unless otherwise instructed.

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: Conestoga-Rovers

Date: August 25, 1989

PDL Project: 15639

Analyst: Ron Sturm

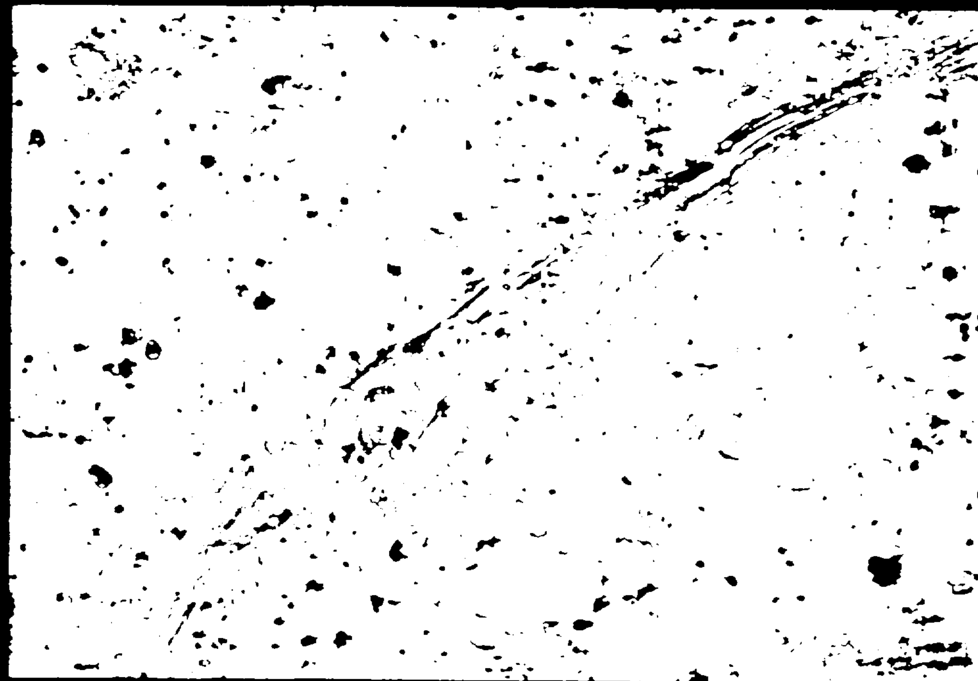
PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*----- Cellulose	Fibrous Glass	Other Fibers
7826 B	S2980-082289-SJ-009	Chrysotile/<1	1-3	<1	--
7827 B	S2980-082289-SJ-010	<1**	1-3	<1	-- c
7828 B	S2980-082289-SJ-011	<1**	1-3	<1	-- c
7829 B	S2980-082289-SJ-012	<1**	1-3	<1	-- c

c = Predominant Components of the Sample are Mixed Silicates, Carbonate & Clays. Amphiboles are Present as Cleavage Fragments and Grains, However, Fibrous Forms are not Detected.

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.

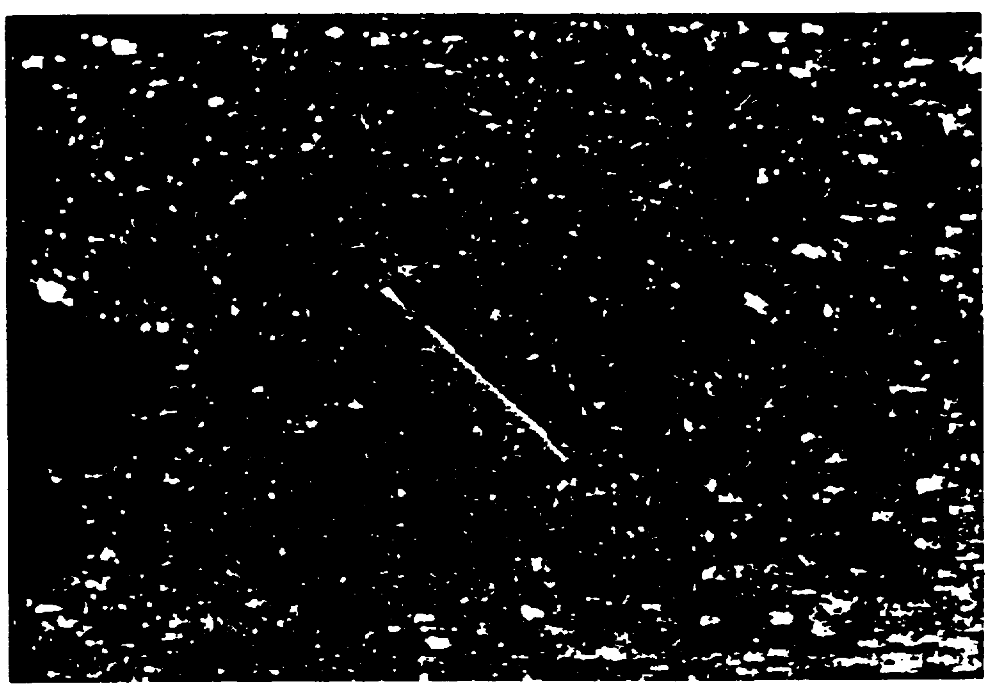
PARTICLE DATA LABORATORIES, LTD. PDL Project: 15639



Magnification 100X Sample 7826 B

Magnification 100X Sample 7827 B

Magnification 100X Sample 7828 B



Magnification 100X Sample 7829 B

Rec'd CRA 15639

AUG

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): PARTICLE ~~DATA~~

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2980

PROJECT NAME: Manville Site Remediation

SAMPLER'S SIGNATURE (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE ~~LOCATOIN~~ ID	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
1	—	8-22-89	1311	S2980-082289-SJ-009	Soil	1	Asbestos
2	—	↓	1325	S2980-082289-SJ-010	Soil	1	Asbestos
3	—	↓	1340	S2980-082289-SJ-011	Soil	1	Asbestos
4	—	↓	1345	S2980-082289-SJ-012	Soil	1	Asbestos
				TOTAL NUMBER OF CONTAINERS		4	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY	DATE/TIME	RECEIVED BY
1 (SIGN)	8-23-89 0640	2 (SIGN)
2 David Dempsey (SIGN)	8/23/89 8:49am	3 (SIGN)
3 (SIGN)		4 (SIGN)

ADDITIONAL SIGNATURE SHEET REQUIRED ☐

METHOD OF SHIPMENT	SHIPPED BY	RECEIVED FOR LABORATORY BY	DATE/TIME
Car	D. Dempsey	(SIGN) Carol Letson	8/23/89 8:42

CONDITION OF SEAL UPON RECEIPT:

GENERAL CONDITION OF COOLER:

COOLER OPENED BY: (SIGN)

DATE/TIME

WHITE - CRA OFFICE COPY
YELLOW - RECEIVING LABORATORY COPY
PINK - CRA LABORATORY COPY
GOLDEN ROD - SHIPPERS

Nº 005871

EMS LABORATORIES
507 Mission Stre
South Pasadena, C
91030-303
818-441-239

DATE: Feb. 22, 1990

CLIENT: CC Johnson & Malhotra
3310 Eagle Park Dr. NE Ste. #101
Grand Rapids, MI 49505

ATTENTION: Joseph Mark / Chetan Trivedi

REFERENCE: Manville / Waukegan

REPORT NO: 17622

SUBJECT: ANALYSIS OF SOIL SAMPLES FOR ASBESTOS

Seventeen soil samples were received on Feb. 9, 1990 for analysis of asbestos content.

The soil samples were analyzed by the polarized light microscopy technique described in "The Interim Method for Determination of Asbestos in Bulk Insulation Samples" (USEPA, December 1982). The sample was homogenized by the use of a ripple splitter. Conglomerated material was disaggregated by using a rubber mallet as not to crush rock fragments.

The limit of detection is generally regarded as approximately 1 percent by Polarized Light Microscopy (P.L.M.). The procedure is also limited by the width of the fiber bundles, which should be at least 2 um in width in order to be analyzed by P.L.M..

The laboratory results are enclosed.

Respectfully submitted,

EMS LABORATORIES, INC.

Patricia Johnsen
Patricia Johnsen
Optical Microscopist

A.J. Kolk, Jr.
Technical Director

PJ/AJK/bg

Encl.

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): EMS LABS

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2980

PROJECT NAME: Manville, WAUKEGAN

SAMPLER'S SIGNATURE (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE ~~LOCATION~~ ID	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
1	—	2-7-90	1326	S2490-020790SS-017	Bulk-Soil	1	Asbestos
2	—		1340	018		1	
3	—		1350	019		1	
4	—		1400	020		1	
5	—		1408	021		1	
6	—		1415	022		1	
7	—		1420	023		1	
8	—		1430	024		1	
9	—		1440	025		1	
10	—		1450	026		1	
11	—		1500	027		1	
12	—		1515	028		1	
13	—		1540	029		1	
14	—	2-8-90	1350	S2480-020890-SS-030	Soil	1	
15	—		1355	031		1	
16	—		1400	032		1	
17	—		1405	033		1	
				TOTAL NUMBER OF CONTAINERS		17	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY: 1 (SIGN)	DATE/TIME 2/8/90 1445	RECEIVED BY: 2 Randall L. Mattes (SIGN)
RELINQUISHED BY: 2 Randall L. Mattes (SIGN)	DATE/TIME 2/8/90 17:20	RECEIVED BY: 3 (SIGN)
RELINQUISHED BY: 3 (SIGN)	DATE/TIME	RECEIVED BY: 4 (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: Fed Express	SHIPPED BY: Karan Mattes	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME 2-9-90 10AM
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER: ok		COOLER OPENED BY: (SIGN)	DATE/TIME 2-9-90 10:15AM

WHITE - CRA OFFICE COPY
YELLOW - RECEIVING LABORATORY COPY
PINK - CRA LABORATORY COPY
GOLDEN ROD - SHIPPERS

Fed Ex Bill #
5375756773

Nº 005976

SUBMITTAL FORM/*For Air Samples*

RUSH YES ☐ NO ☐ Other ______
<8hr. ☐ 24hr. ☐ 48hr. ☐ Weekend ☐

►Client ______________________ ►Date of Shipment ______________ ►Carrier ______
►Address ______________________ ►Package Shipped From ______________
______________________ ►Job No. ______________
►Telephone ______________________ ►Purchase Order No. ______________
►Contact ______________________ ►Project ID ______________

►Results Requested Via VERBAL ☐ - FAX ☐ ►Client FAX No. ______________
(NOTE: Complete written reports will follow all analyses, in addition to any prior transmitted verbal or fax results.)

►No. of Samples Sent ______________ ►Cassette Lot No. ______________
►Comments ______________________ ►Manufacturer ______________ ►Distributor ______
______________________ ►Filter Diameter(mm) ______ 25mm ☐ 37mm ☐
______________________ ►Filter Lot No. ______________
______________________ ►5.0μm Diffusion Filter Lot No. ______________
______________________ ►Manufacturer ______________ ►Distributor ______
►PCM ☐ *TEM ☐ SEM ☐ ►Counting Rules ______________
(*NOTE: Cassettes and filters supplied by EMS for TEM analysis are tested by batch to be asbestos-free.)

No.	Description	[illegible]	[illegible]	[illegible]	[illegible]	Receiver ID No.	Assigned No.
1							
2							

►Laboratory No. ______________ ►Received By ______________ ►Time ______
►Date of Package Delivery ______________ ►Shipping Bill Retained: YES ☐ NONE ☐

►Condition of Package on Receipt ______________ ►Condition of Custody Seal ______________
(NOTE: If the package has sustained substantial damage or the custody seal is broken, stop and contact the project manager and the shipper.)

►No. of Samples ______________ ►Chain-of-Custody Signature ______________
►Date of Acceptance into Sample Bank ______________ ►Comments ______________
►Disposition of Samples ______________

SUBMITTAL FORM For Air Samples

RUSH: YES ☐ NO ☐ Other ☐
<8hr. ☐ 24hr. ☐ 48hr. ☐ Weekend ☐

►Client ____________________ ►Date of Shipment __________ ►Carrier __________
►Address ____________________ ►Package Shipped From __________
____________________ ►Job No. __________
►Telephone ____________________ ►Purchase Order No. __________
►Contact ____________________ ►Project ID __________

►Results Requested Via VERBAL ☐ FAX ☐ ►Client FAX No. __________
(NOTE: Complete written reports will follow all analyses, in addition to any prior transmitted verbal or fax results.)

►No. of Samples Sent ____________________ ►Cassette Lot No. __________
►Comments ____________________ ►Manufacturer __________ ►Distributor __________
____________________ ►Filter Diameter(mm) ______ 25mm ☐ 37mm ☐
____________________ ►Filter Lot No. __________
____________________ ►5.0µm Diffusion Filter Lot No. __________
____________________ ►Manufacturer __________ ►Distributor __________
►PCM ☐ *TEM ☐ SEM ☐ ►Counting Rules __________
(*NOTE: Cassettes and filters supplied by EMS for TEM analysis are tested by batch to be asbestos-free.)

No.	Description	PC	MCE	[illegible] µm	[illegible] (liters)	Received ID No.	Assigned No.

►Laboratory No. ____________________ ►Received By ____________________ ►Time ______
►Date of Package Delivery ____________________ ►Shipping Bill Retained: YES ☐ NONE ☐

►Condition of Package on Receipt ____________________ ►Condition of Custody Seal ____________________
(NOTE: If the package has sustained substantial damage or the custody seal is broken, stop and contact the project manager and the shipper.)

►No. of Samples ____________________ ►Chain-of-Custody Signature ____________________
►Date of Acceptance into Sample Bank ____________________ ►Comments ____________________
►Disposition of Samples ____________________

LABORATORY NO.: 1762

SAMPLE ID: 017

CLIENT: C.C. Johnson & Malhotra

	SIZE: Fine <0.5mm.		SIZE: Coarse >0.5mm.
FRACTION WEIGHT	212.8g	FRACTION WEIGHT	139.9g
SAMPLE APPEARANCE	Grey granular White fibrous	SAMPLE APPEARANCE	Grey granular Black / white fibrous
SIZE RANGE	5µm to 100µm	SIZE RANGE	100µm to 14mm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Small bundles of chrysotile were found in all 4 preps.	ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Large bundles of chrysotile and crocidolite in all 4 preps.
ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 2%	ASBESTOS PRESENT TYPE & PERCENT	Crocidolite 9% Chrysotile 5%
OTHER FIBROUS MATERIALS PRESENT	Cellulose 1% Glasswool <1% Synthetics <1%	OTHER FIBROUS MATERIALS PRESENT	Cellulose <1% Synthetics <1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques, organics, Mica (t)	NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques, organics
NO. OF FIELDS VIEWED	100 fields per prep	NO. OF FIELDS VIEWED	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. Chry.3% 2. Chry.1% 3. Chry.2% 4. Chrys. 2%	PERCENT ASBESTOS PER SLIDE	1. Croc.8% Chry.5% 2. Chry.2% Croc.12% 3. Croc.7% Chry.6% 4. Croc.10% Chry.7%

N.D. = NONE DETECTED

t = TRACE

RECEIVED

LABORATORY NO.: 17622
SAMPLE ID: 018

CLIENT: CC Johnson & Malhotra

	SIZE: Fine <0.5mm.	SIZE: Coarse >0.5mm.
FRACTION WEIGHT	53.6g	77.7g
SAMPLE APPEARANCE	Grey granular	Grey granular
SIZE RANGE	5 - 15µm	5 - 50µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Crocidolite was found in one prep	Chrysotile was seen in one prep in association with the tar
ASBESTOS PRESENT TYPE & PERCENT	Crocidolite <<1%	Chrysotile <<1%
OTHER FIBROUS MATERIALS PRESENT	Cellulose <1%	Cellulose <1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques Organics	Granular minerals Organics Opaques Organics (Tar) (t)
NO. OF FIELDS VIEWED	100 fields per prep	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. N.D. 2. Cro <1% 3. N.D. 4. N.D.	1. N.D. 2. Chry <1% 3. N.D. 4. N.D.

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.:	17622	CLIENT:	CC Joh..son & Malhotra
SAMPLE ID:	019		
SIZE: Fine <0.5mm.		SIZE: Coarse >0.5mm.	
FRACTION WEIGHT	125.2g	FRACTION WEIGHT	286.4g
SAMPLE APPEARANCE	Grey granular White fibrous	SAMPLE APPEARANCE	Grey granular White fibrous
SIZE RANGE	10 to 150µm	SIZE RANGE	10 to 250µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Chrysotile and amosite were found in all 4 of the preps and crocidolite was found in one prep	ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Chrysotile and amosite were found in all four preps
ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 5% Amosite 1+% Crocidolite <<1%	ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 14% Amosite 2%
OTHER FIBROUS MATERIALS PRESENT	Glasswool <1% Cellulose <1% Synthetics <1%	OTHER FIBROUS MATERIALS PRESENT	Cellulose <1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques Organics	NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques Organics Mica
NO. OF FIELDS VIEWED	100 fields per prep	NO. OF FIELDS VIEWED	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1 Chry.4% Amo.1% Croc.<1% 2 Chry.7% Amo.<1% 3 Chry.3% Amo.2% Croc.<1% 4. Chry.5% Amo.3%	PERCENT ASBESTOS PER SLIDE	1 Chry.15% Amo.1% 2. Chry.15% Amo.1% 3 Chry.12% Amo.3% 4. Chry.10% Amo.2%

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.: 17622	CLIENT: CC Johnson & Malhotra
SAMPLE ID: 020	
SIZE: Fine <0.5mm.	SIZE: Coarse >0.5mm.

	Fine <0.5mm.		Coarse >0.5mm.
FRACTION WEIGHT	115.3g	FRACTION WEIGHT	476.7g
SAMPLE APPEARANCE	Grey granular White fibrous	SAMPLE APPEARANCE	Black / White Fibrous
SIZE RANGE	10µm to 500µm	SIZE RANGE	100µm to 5mm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Large bundles of chrysotile were found in all four preps	ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Large bundles of chrysotile were found in all four preps
ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 15% Crocidolite <1%	ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 26% Crocidolite <1%
OTHER FIBROUS MATERIALS PRESENT	Cellulose 3% Stellate hairs <1% Glasswool <1%	OTHER FIBROUS MATERIALS PRESENT	Cellulose 1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques Organics Resin	NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques Organics Resin
NO. OF FIELDS VIEWED	100 fields per prep	NO. OF FIELDS VIEWED	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. Chry.20% Croc.<1% 2. Chry.18% Croc.<1% 3. Chry.15% Croc.<1% 4. Chry.8% Croc.<1%	PERCENT ASBESTOS PER SLIDE	1. Chry.20% Croc.<1% 2. Chry.25% Croc.<1% 3. Chry.35% 4. Chry.25% Croc.<1%

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.:	17622	CLIENT:	CC Johnson & Malhotra
SAMPLE ID:	021		
SIZE: Fine <0.5mm.		SIZE: Coarse >0.5mm.	
FRACTION WEIGHT	92.2g	FRACTION WEIGHT	301.1g
SAMPLE APPEARANCE	Grey granular White fibrous	SAMPLE APPEARANCE	Grey granular Grey fibrous
SIZE RANGE	10 to 80µm	SIZE RANGE	10 to 200µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Chrysotile was found in all 4 preps and amosite was found in two preps and crocidolite in 1 prep	ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Chrysotile and crocidolite were found in all 4 preps and amosite was found in two preps
ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 5% Crocidolite <1% Amosite <1%	ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 10% Crocidolite 1+% Amosite <1%
OTHER FIBROUS MATERIALS PRESENT	Glasswool 5% Cellulose 1%	OTHER FIBROUS MATERIALS PRESENT	Glasswool 1% Cellulose 1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Organics Opaques Mica (t)	NON-FIBROUS MATERIALS PRESENT	Granular minerals Organics Opaques
NO. OF FIELDS VIEWED	100 fields per prep	NO. OF FIELDS VIEWED	100 fileds per prep
PERCENT ASBESTOS PER SLIDE	1. Chry.4% Croc.<1% Amo.<1% 2. Chry.5% Croc.1% 3. Chry.3% Amo.<1% 4. Chry.8% Amo.<1%	PERCENT ASBESTOS PER SLIDE	1. Chry.15% Amo.1% Cro.<1% 2. Chry.6% Amo.<1% Cro.2% 3. Chry.8% Croc.1% 4. Chry.10% Croc.3% Amo.<1%

N.D. = NONE DETECTED

t = TRACE

	Fine	Coarse
LABORATORY NO.:	17662	
SAMPLE ID:	022	
CLIENT:		CC Jonnson & Malhotra
SIZE:	Fine <0.5mm.	Coarse >0.5mm.
FRACTION WEIGHT	31.6g	318.6g
SAMPLE APPEARANCE	Grey granular	Grey massive & granular
SIZE RANGE	5μm to 5mm	50μm to 10mm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Small to large bundles of crocidolite & chrysotile were found in all four preps	Large bundles of chrysotile and amosite were found in all four preps
ASBESTOS PRESENT TYPE & PERCENT	Crocidolite 9% Chrysotile 1+%	Chrysotile 9+% Crocidolite 9%
OTHER FIBROUS MATERIALS PRESENT	Cellulose 2% Synthetics <1%	Cellulose 1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Organics Opaques	Granular minerals Opaques Organics Resin
NO. OF FIELDS VIEWED	100 fields per prep	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. Croc.9% Chry.1% 2. Croc.10% Chry.1% 3. Croc.10% Chry.2% 4. Croc.6% Chry.2%	1. Chry.15% Croc.5% 2. Chry.8% Croc. 10% 3. Chry.10% Croc. 8% 4. Chry.5% Croc. 12%

N.D. = NONE DETECTED

t = TRACE

	Fine	Coarse
LABORATORY NO.:	17622	
SAMPLE ID:	023	
CLIENT:		CC Joh...on & Malhotra
SIZE:	Fine <0.5mm.	Coarse >0.5mm.
FRACTION WEIGHT	212.0g	115.8g
SAMPLE APPEARANCE	Beige granular White fibrous	Blue / White fibrous
SIZE RANGE	10µm to 200µm	100µm to 8mm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Large bundles of chrysotile were found in all four preps. Small bundles of crocidolite were found in all four preps	Large bundles of chrysotile were found in all four preps. Small bundles of crocidolite were found in the four preps.
ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 6% Crocidolite <1%	Chrysotile 39% Crocidolite 1+%
OTHER FIBROUS MATERIALS PRESENT	Cellulose 4% Glasswool 1%	Cellulose 2%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Organics Opaques Resin (t) Mica (t)	Granular minerals Organics Resin Opaques
NO. OF FIELDS VIEWED	100 fields per prep	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. Chry.8% Croc.1% 2. Chry.3% Croc.<1% 3. Chry.6% Croc.<1% 4. Chry.6% Croc.<1%	1. Chry.25% Croc.4% 2. Chry.45% Croc. 1% 3. Chry.45% Croc.1% 4. Chry.40% Croc.<1%

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.:	17622	CLIENT: CC Johnson & Malhotra
SAMPLE ID:	024	
	SIZE: Fine <0.5mm.	SIZE: Coarse >0.5mm.
FRACTION WEIGHT		88.2g
SAMPLE APPEARANCE	No fine fraction was present in this sample	Grey granular white fibrous
SIZE RANGE		10µm to 5mm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY		Large bundles of chrysotile were found in all four preps
ASBESTOS PRESENT TYPE & PERCENT		Chrysotile 19% Crocidolite 1+%
OTHER FIBROUS MATERIALS PRESENT		Cellulose <1%
NON-FIBROUS MATERIALS PRESENT		Granular minerals Resin, Opaques
NO. OF FIELDS VIEWED		100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. 2. 3. 4.	1. Chry.12% Croc.2% 2. Chry.15% Croc. 1% 3. Chry.20% Croc.3% 4. Chry.30% Croc.<1%

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.: 17622

SAMPLE ID: 025

CLIENT: CC Johnson & Malhotra

	SIZE: Fine <0.5mm.	SIZE: Coarse >0.5mm.
FRACTION WEIGHT	18.8g	271.8g
SAMPLE APPEARANCE	Grey & White granular	Grey & White fibrous
SIZE RANGE	5µm to 50µm	50µm to 200µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Chrysotile was found in all four preps. Amosite in 2 of the 4 preps and crocidolite in 3 of the 4 preps.All were found in small bundles	Large bundles of chrysotile and crocidolite were found in all four preps
ASBESTOS PRESENT TYPE & PERCENT	Amosite <<1% Chrysotile 2% Crocidolite <1%	Chrysotile 5% Crocidolite 6%
OTHER FIBROUS MATERIALS PRESENT	Cellulose 1%	Cellulose <1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Organics Opaques	Granular minerals Organics Opaques Mica (t)
NO. OF FIELDS VIEWED	100 fields per prep	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1 Chry.3% Croc.<1% Amo.<1% 2 Chry.1% Croc.<1% 3 Chry<1% Amo.<1% 4. Chry.1+% Croc.<1%	1 Chry.7% Croc.6% 2. Chry.4% Croc.6% 3 Chry.3% Croc.6% 4. Chry. 5% Croc.5%

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.: 17622
SAMPLE ID: 026

CLIENT: CC Johnson & Malhotra

	SIZE: Fine <0.5mm.	SIZE: Coarse >0.5mm.
FRACTION WEIGHT	N/A	308.1g
SAMPLE APPEARANCE	No fine fraction was present in this sample	Grey granular Black fibrous White fibrous
SIZE RANGE		10µm to 300µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY		Large bundles of chrysotile were found in all four preps.
ASBESTOS PRESENT TYPE & PERCENT		Crocidolite ≤1% Chrysotile 4%
OTHER FIBROUS MATERIALS PRESENT		Glasswool 15% Cellulose 2% Fiberglass <1%
NON-FIBROUS MATERIALS PRESENT		Granular minerals Resin Opaques Organics (tar) (t)
NO. OF FIELDS VIEWED		100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. 2. 3. 4.	1. Croc.<1% Chry.2% 2. Croc. 2% Chry.4% 3. Chry.2% Croc.<1% 4. Chry.8% Croc. <1%

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.: 17622

SAMPLE ID: 027

CLIENT: CC Johnson & Malhotra

	SIZE: Fine <0.5mm.	SIZE: Coarse >0.5mm.
FRACTION WEIGHT	168.9g	134.4g
SAMPLE APPEARANCE	Grey Fibrous & Brown Granular	White Fibrous
SIZE RANGE	10-100 µm	10-80 µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Chrysotile was found in all of the four preps and crocidolite was found in one of the preps	Chrysotile was found in all of the four preps and crocidolite was found in one of the preps
ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 6% Crocidolite <<1%	Chrysotile 4% Crocidolite <<1%
OTHER FIBROUS MATERIALS PRESENT	Cellulose 12%	Cellulose 5%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques, Organics Mica (t)	Granular minerals Organics Opaques
NO. OF FIELDS VIEWED	100 fields per prep	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. Chry.5% 2. Chry.3% Croc.<1% 3. Chry.7% 4. Chry.8%	1. Chry.4% 2. Chry.5% Croc.<1% 3. Chry.4% 4. Chry.4%

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.: 17622 SAMPLE ID: 028 SIZE: Fine <0.5mm.		CLIENT: CC Johnson & Malhotra SIZE: Coarse >0.5mm.	
FRACTION WEIGHT	N/A	FRACTION WEIGHT	126.7g
SAMPLE APPEARANCE	No fine fraction was present in this sample	SAMPLE APPEARANCE	Grey massive Granular with white fibers
SIZE RANGE		SIZE RANGE	50µm to 3 mm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY		ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Large bundles of chrysotile were found in all four preps
ASBESTOS PRESENT TYPE & PERCENT		ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 12%
OTHER FIBROUS MATERIALS PRESENT		OTHER FIBROUS MATERIALS PRESENT	Cellulose <1% Synthetics<1%
NON-FIBROUS MATERIALS PRESENT		NON-FIBROUS MATERIALS PRESENT	Granular minerals Resin Opaques
NO. OF FIELDS VIEWED		NO. OF FIELDS VIEWED	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. 2. 3. 4.	PERCENT ASBESTOS PER SLIDE	1. Chry.5% 2. Chry.18% 3. Chry.15% 4. Chry.10%

N.D. = NONE DETECTED

t = TRACE

	SIZE: Fine <0.5mm.		SIZE: Coarse >0.5mm.
LABORATORY NO.:	17622	CLIENT:	CC Johnson & Malhotra
SAMPLE ID:	029		
FRACTION WEIGHT	105.3g	FRACTION WEIGHT	261.6g
SAMPLE APPEARANCE	Brown granular	SAMPLE APPEARANCE	Grey granular & Yellow fibrous
SIZE RANGE	10 - 150µm	SIZE RANGE	10 - 250µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Chrysotile was found in all four of the preps and crocidolite was found in two of the preps	ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Chrysotile was found in all four preps
ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 2% Crocidolite ≤1%	ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 12%
OTHER FIBROUS MATERIALS PRESENT	Glasswool 40% Cellulose <1%	OTHER FIBROUS MATERIALS PRESENT	Cellulose 1% Glasswool 2% Synthetics <1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques Organics	NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques Organics
NO. OF FIELDS VIEWED	100 fields per prep	NO. OF FIELDS VIEWED	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. Chry.1% Croc.<1% 2. Chry.2% 3. Chry.2% Croc.<1% 4. Chry. 2% Croc. 1%	PERCENT ASBESTOS PER SLIDE	1. Chry.10% 2. Chry.15% 3. Chry.5% 4. Chry.20%

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.: 17622
SAMPLE ID: 030

CLIENT: CC Johnson & Malhotra

	SIZE: Fine <0.5mm.	SIZE: Coarse >0.5mm.
FRACTION WEIGHT	207g	694.1g
SAMPLE APPEARANCE	Grey granular	Grey granular
SIZE RANGE	5 - 100µm	5 - 200 µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Small bundles of crocidolite were found in one prep	No asbestiform minerals were detected in any of the preps
ASBESTOS PRESENT TYPE & PERCENT	Crocidolite <<1%	N.D.
OTHER FIBROUS MATERIALS PRESENT	Synthetics <1% Glasswool <1% Cellulose 1%	Cellulose <1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Resin Opaques	Granular minerals Resin Opaques
NO. OF FIELDS VIEWED	100 fields per prep	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. N.D. 2. N.D. 3. Cro.<<1% 4. N.D.	1. N.D. 2. N.D. 3. N.D. 4. N.D.

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.:	17622	CLIENT:	CC Johnson & Malhotra
SAMPLE ID:	031		
SIZE: Fine <0.5mm.		SIZE: Coarse >0.5mm.	
FRACTION WEIGHT	184g	FRACTION WEIGHT	665.3g
SAMPLE APPEARANCE	Grey granular	SAMPLE APPEARANCE	Grey granular
SIZE RANGE	10 to 60 µm	SIZE RANGE	5 to 20 µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Chrysotile was found in all four preps and amosite in 3 preps and crocidolite in one prep	ANALYSIS DESCRIPTION i.e. MORPHOLOGY	A small bundle of crocidolite was found in one of the preps
ASBESTOS PRESENT TYPE & PERCENT	Chrysotile 1+% Amosite <1% Crocidolite <<1%	ASBESTOS PRESENT TYPE & PERCENT	Crocidolite <<1%
OTHER FIBROUS MATERIALS PRESENT	Glasswool 2% Cellulose 3% Synthetics 1%	OTHER FIBROUS MATERIALS PRESENT	Cellulose 2% Synthetics <1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Organics Opaques	NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques Organics
NO. OF FIELDS VIEWED	100 fields per prep	NO. OF FIELDS VIEWED	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1 Chry.1% 2 Chry. 1% Amo.<1% Amo<1% 3 Chry.2% 4 Chry. 2% Amo.<1% Croc.<1%	PERCENT ASBESTOS PER SLIDE	1. N.D. 2. N.D. 3. Croc.<1% 4. N.D.

N.D. = NONE DETECTED

t = TRACE

LABORATORY NO.: 17622 SAMPLE ID: 032 SIZE: Fine <0.5mm.		CLIENT: CC Johnson & Malhotra SIZE: Coarse >0.5mm.	
FRACTION WEIGHT	472.6g	FRACTION WEIGHT	420g
SAMPLE APPEARANCE	Grey granular	SAMPLE APPEARANCE	Grey granular
SIZE RANGE	5 - 120 µm	SIZE RANGE	5 - 200 µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Small bundles of Chrysotile were found in 2 of the preps	ANALYSIS DESCRIPTION i.e. MORPHOLOGY	No asbestiform minerals were found in any of the preps
ASBESTOS PRESENT TYPE & PERCENT	Chrysotile <1%	ASBESTOS PRESENT TYPE & PERCENT	None detected
OTHER FIBROUS MATERIALS PRESENT	Cellulose <1% Glasswool <1%	OTHER FIBROUS MATERIALS PRESENT	Cellulose 1+%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Resin Opaques	NON-FIBROUS MATERIALS PRESENT	Granular minerals Resin Opaques
NO. OF FIELDS VIEWED	100 fields per prep	NO. OF FIELDS VIEWED	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. Chry.1% 2. N.D. 3. Chry.<1% 4. N.D.	PERCENT ASBESTOS PER SLIDE	1. N.D. 2. N.D. 3. N.D. 4. N.D.

N.D. = NONE DETECTED t = TRACE

LABORATORY NO.:	17622	CLIENT:	CC Johnson & Malhotra
SAMPLE ID:	033		
SIZE: Fine <0.5mm.		SIZE: Coarse >0.5mm.	
FRACTION WEIGHT	214.6g	FRACTION WEIGHT	543.5g
SAMPLE APPEARANCE	Grey granular with with brown organic fibers	SAMPLE APPEARANCE	Grey massive Granular
SIZE RANGE	5µm to 30µm	SIZE RANGE	10µm to 40µm
ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Very small bundles chrysotile fibers were found in all four preps	ANALYSIS DESCRIPTION i.e. MORPHOLOGY	Very small bundles of chrysotile fibers were found in all four preps. Crocidolite was found in one prep
ASBESTOS PRESENT TYPE & PERCENT	Chrysotile <1%	ASBESTOS PRESENT TYPE & PERCENT	Chrysotile <1% Crocidolite <<1%
OTHER FIBROUS MATERIALS PRESENT	Cellulose 2%	OTHER FIBROUS MATERIALS PRESENT	Cellulose 2% Glasswool <1%
NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques Organics Mica	NON-FIBROUS MATERIALS PRESENT	Granular minerals Opaques Organics Mica (t)
NO. OF FIELDS VIEWED	100 fields per prep	NO. OF FIELDS VIEWED	100 fields per prep
PERCENT ASBESTOS PER SLIDE	1. Chry<1% 2. Chry.<1% 3. Chry<1% 4. Chry.<1%	PERCENT ASBESTOS PER SLIDE	1. Chry<1% 2. Chry.<1% Croc.<1% 3. Chry<1% 4. Chry.<1%

N.D. = NONE DETECTED t = TRACE

2980

PARTICLE DATA LABORATORIES, LTD.

115 Hann Street • Elmhurst, Illinois 60126 • (708) 832-5658

February 27, 1991

Ms. Therese Dorigan
Conestoga-Rovers & Associates, Inc.
10400 W. Higgins Road
Suite 103
Rosemont, Illinois 60018

CHECKED AGAINST PRELIMINARY DATA
Date 3/5/91
Initials TS

RE: Examination of Bulk Samples for Asbestos
P.O. Number: 2980
Location: Manville Disposal Site
PDL Project: 17010
EPA Lab I.D. Number 5118

Dear Ms. Dorigan:

The following report consists of asbestos identification by polarized light microscopy of the samples received 2-15-91.

The samples were not collected by Particle Data personnel.

It has been a pleasure serving you, and we look forward to serving you again in the near future. If you have any questions concerning this report, please do not hesitate to call us at Particle Data Laboratories, Ltd.

Respectfully submitted,

PARTICLE DATA LABORATORIES, LTD.

John Aschbacher
Microscopist

ENCLOSURES

PARTICLE DATA LABORATORIES, LTD.

DETERMINATION OF ASBESTOS IN BULK SAMPLES

The attached information tabulates the quantities of fibrous material found in each sample submitted for analysis. Each roll lists horizontally (1) a unique PDL log number, (2) any available sample identification information, (3) a short sample description, and (4) the percentage breakdown for all fibrous component present in each sample. The numbers may not necessarily add up to 100%, with the balance being filler and binder materials. When a sample is labeled as heterogeneous, there exists the possibility of significantly higher local concentrations than the averaged value reported. This could result in local high airbourne asbestos fiber levels if the material is disturbed and appropriate safety precautions are indicated. The symbol (--) indicates "not detected."

METHOD

Identification and quantifications are performed in accordance with the U.S. Environmental Protection Agency "Interim Method for the Determination of Asbestos in Bulk Insulation Samples," 40 CFR Part 763, Subpart F, App. A, 1987. Analysis is initiated by a gross examinaton of the sample as received. A low power stereomicroscope is routinely used to aid in fiber characterization and quantification. Any obvious fractions are noted and samples of each fraction are mounted for polarized light microscopy in a 1.515 index liquid. When mounting samples any fibrous material present is thoroughly separated for examination. Preliminary evaluation to determine the possible species of asbestos present is performed by morphology, sign of elongation, birefringence and refractive index relative to the mounting fluid. When asbestos type fibers are seen morphologically, they are additionally characterized by immersion matching in refractive index liquids using white light and/or sodium d-line. A numeric determination of birefringence is available based on the index measurements. A sample must fit into the accepted ranges of indices, birefringence and morphological features to be classed as asbestos.

Concurrently the relative abundance of any asbestos material, other fibers, fillers and binders is determined. Quantities reported are estimates based on areal coverage and thickness of the various species present. Reference samples of varied and known concentrations are used to help establish area percents of fibrous components present in each sample. However, point counting may be conducted on difficult samples or when a secondary quantification technique is necessary. The term "trace-1%" means the denoted component is detected but in quantities less than or equal to 1%. Ranges in percentages may be reported when sample inhomogeneity prevents the determination of more precise value. Identification of non-asbestos material is not as rigorous, as these are not the species of primary interest.

PARTICLE DATA LABORATORIES, LTD.

ASBESTOS CHARACTERIZATION

The features of the various forms of asbestos are as follows:

Chrysotile: Thin fibers and fiber bundles with both straight and wavy sections. The ends of bundles tend to be frayed. Sign of elongation is positive, indices are 1.493-1.560 (α) and 1.517-1.562 (γ), birefringence of 0.004-0.016 and the fibers exhibit parallel extinction.

Amosite: Straight thin single fibers and bundles of such fibers usually with cleanly broken ends on individual fibers; positive sign of elongation, refractive indices of 1.635-1.696 (α) and 1.655-1.729 (γ), birefringence of 0.020-0.033 and fibers exhibit parallel extinction.

Crocidolite: Similar in morphology to amosite but is distinguished by negative sign of elongation, blue to blue green pleochroic coloration and indices of 1.654-1.701 (α) and 1.668-1.717 (γ), and birefringence of 0.009-0.016. It is commonly referred to as blue asbestos.

Anthophyllite: Similar in morphology to amosite but indices of 1.596-1.652 (α) and 1.615-1.676 (γ) and birefringence of 0.013-0.025. Also, Anthophyllite fibers show a positive sign of elongation and parallel extinction.

Tremolite-Actinolite Series: Transparent, elongated furrowed prisms, usually with uneven, jagged ends and smooth sides, with oblique (0-20°) to parallel extinction and positive elongation; indices are 1.599-1.668 (α) and 1.622-1.688 (γ) and birefringence is 0.020-0.028. The two minerals are very similar optically and grade into each other.

PHOTOMICROGRAPHS

Also attached are representative photomicrographs of each sample and a compendium of the materials found. The micrographs are taken with crossed polars and a first order red compensator which results in the pink background and shows birefringence as bright colors other than the background and isotropic transparent material as the same color as the background. A short pamphlet which gives a more detailed description and explanation of the features of photomicrography via polarized light microscopy is available at your request.

SAMPLE RETENTION

Samples will be retained for six months unless otherwise instructed. After this period, the sample(s) will be disposed of appropriately. Upon written request, the samples will be returned by mail or delivery for a nominal fee to cover postage and handling. There would be no charge for samples picked up at Particle Data Laboratories.

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT

PARTICLE DATA LABORATORIES, LTD.

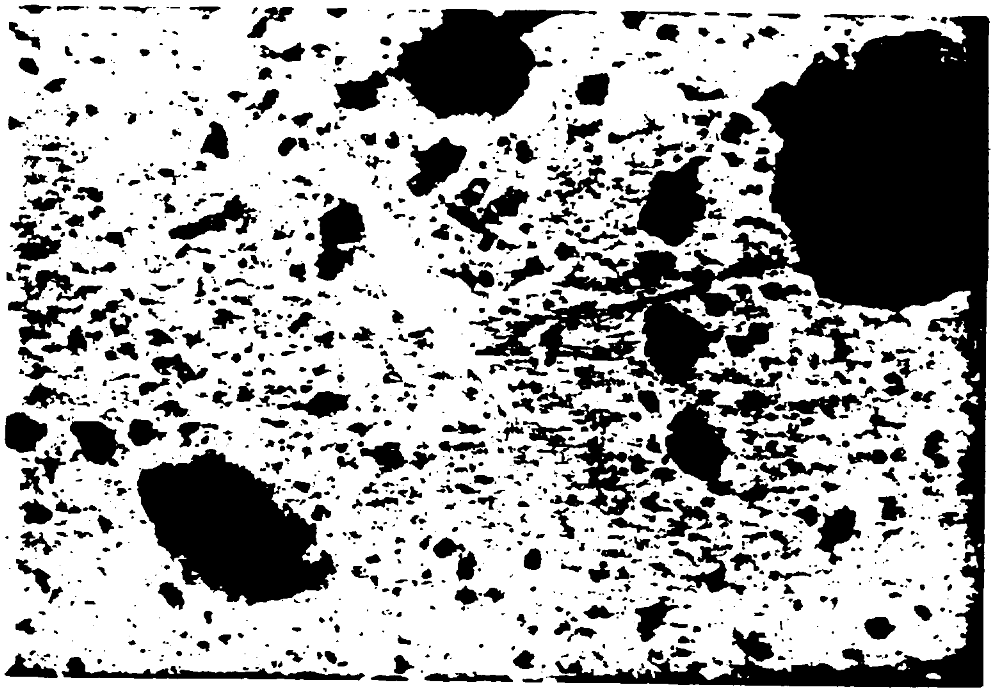
CLIENT: Conestoga-Rovers & Associates, Inc.   PDL PROJECT: 17010

PDL LOG NUMBER	SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	ASBESTOS-FORM MATERIAL (%) CHRYSOTILE	AMOSITE	OTHER	NON ASBESTOS-FORM MATERIAL (%) CELLULOSE	FIBROUS GLASS	OTHER FIBERS
18862-B	S2980-021491-SJ-034	Heterogeneous Gray Fibrous	1-3	Trace-1	--	5-10	--	Wollastonit 5-10 Hair/1-3
18863-B	S2980-021491-SJ-035	Homogeneous Buff Slightly Fibrous	1-3	Trace-1	--	3-5	Trace-1	--
18865-B	S2980-021491-SJ-036	Homogeneous White Slightly Fibrous	--	--	--	--	Trace-1	--
---	---	---	--	--	--	--	--	--
---	---	---	--	--	--	--	--	--

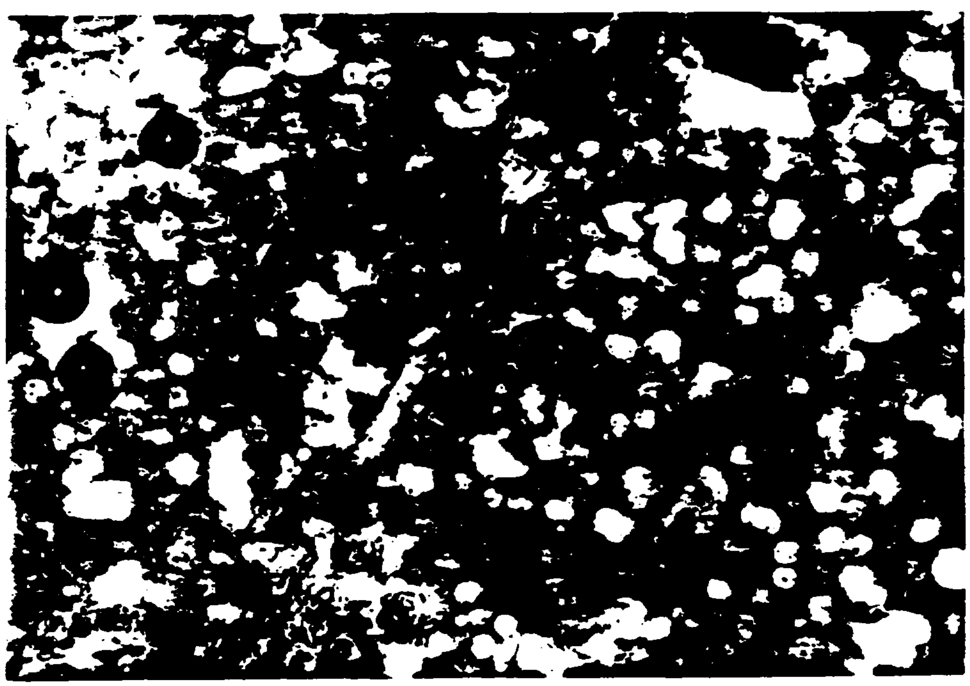
ABBREVIATIONS: CROC.-CROCIDOLITE   TREM.-TREMOLITE   SYNTH.-SYNTHETIC FIBERS
ANTH.-ANTHOPHYLLITE   ACTIN.-ACTINOLITE   CaSil-CALCIUM SILICATES

COMMENTS:

MICROSCOPIST: John Aschbacher   ANALYSIS DATE: 2/20/91



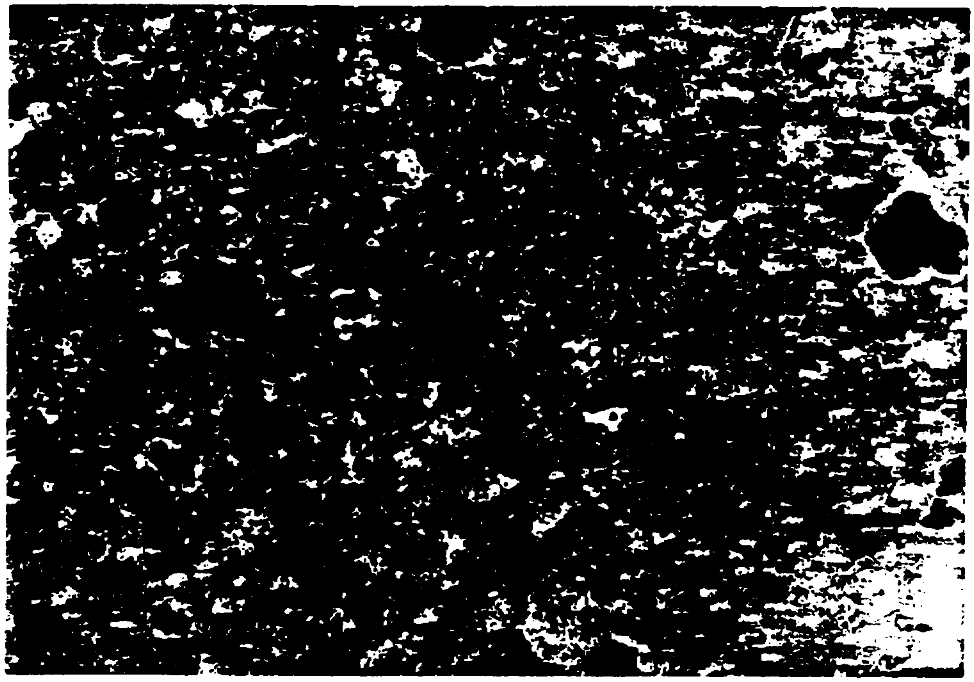
Magnification 100X Sample 18862-B



Magnification 100X Sample 18863-B

PARTICLE DATA LABORATORIES, LTD.

PDL Project: 17010



Magnification 100X Sample 18865-B

17010

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): PARTICLE DATA

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2980

PROJECT NAME: Manville Disposal Site

SAMPLER'S SIGNATURE (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE ~~LOCATOIN~~ ID	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
1	—	2-14-91	1155	S2980-021491-SS-034	BULK	1	ASBESTOS PLM
2	—	2-14-91	1200	S2980-021491-SS-035	BULK	1	ASBESTOS PLM
3	—	2-14-91	1205	S2980-021491-SS-036	BULK	1	ASBESTOS PLM
				TOTAL NUMBER OF CONTAINERS		3	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY:	DATE/TIME	RECEIVED BY:
1 (SIGN)	2-14-91 1430	2 (SIGN)
2 (SIGN)		3 (SIGN)
3 (SIGN)		4 (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT:	SHIPPED BY:	RECEIVED FOR LABORATORY BY:	DATE/TIME
FED EXPRESS		(SIGN) Carol Letson	2/15/91 9:15 AM

CONDITION OF SEAL UPON RECEIPT:
GENERAL CONDITION OF COOLER:

COOLER OPENED BY: (SIGN)
DATE/TIME

WHITE - CRA OFFICE COPY
YELLOW - RECEIVING LABORATORY COPY
PINK - CRA LABORATORY COPY
GOLDEN ROD - SHIPPERS

Nº 005988

2980

PARTICLE DATA LABORATORIES, LTD.

115 Hann Street • Elmhurst, Illinois 60126 • (708) 332-5658

March 1, 1991

Rec'd CRA
MAR 5 1991

Ms. Therese M. Dorigan
Conestoga-Rovers & Associates
10400 W. Higgins Road
Suite 103
Rosemont, Illinois 60018

Date 3/5/91
Initials TD.

RE: Examination of Bulk Samples for Asbestos
P.O. Number: 2980
Location: Manville Site Remediation
PDL Project: 17010
EPA Lab I.D. Number 5118

Dear Ms. Dorigan:

The following report consists of asbestos identification by polarized light microscopy of the samples received 2-22-91.

The samples were not collected by Particle Data personnel.

It has been a pleasure serving you, and we look forward to serving you again in the near future. If you have any questions concerning this report, please do not hesitate to call us at Particle Data Laboratories, Ltd.

Respectfully submitted,

PARTICLE DATA LABORATORIES, LTD.

John Aschbacher
Microscopist

ENCLOSURES

PARTICLE DATA LABORATORIES, LTD.

DETERMINATION OF ASBESTOS IN BULK SAMPLES

The attached information tabulates the quantities of fibrous material found in each sample submitted for analysis. Each roll lists horizontally (1) a unique PDL log number, (2) any available sample identification information, (3) a short sample description, and (4) the percentage breakdown for all fibrous component present in each sample. The numbers may not necessarily add up to 100%, with the balance being filler and binder materials. When a sample is labeled as heterogeneous, there exists the possibility of significantly higher local concentrations than the averaged value reported. This could result in local high airbourne asbestos fiber levels if the material is disturbed and appropriate safety precautions are indicated. The symbol (--) indicates "not detected."

METHOD

Identification and quantifications are performed in accordance with the U.S. Environmental Protection Agency "Interim Method for the Determination of Asbestos in Bulk Insulation Samples," 40 CFR Part 763, Subpart F, App. A, 1987. Analysis is initiated by a gross examinaton of the sample as received. A low power stereomicroscope is routinely used to aid in fiber characterization and quantification. Any obvious fractions are noted and samples of each fraction are mounted for polarized light microscopy in a 1.515 index liquid. When mounting samples any fibrous material present is thoroughly separated for examination. Preliminary evaluation to determine the possible species of asbestos present is performed by morphology, sign of elongation, birefringence and refractive index relative to the mounting fluid. When asbestos type fibers are seen morphologically, they are additionally characterized by immersion matching in refractive index liquids using white light and/or sodium d-line. A numeric determination of birefringence is available based on the index measurements. A sample must fit into the accepted ranges of indices, birefringence and morphological features to be classed as asbestos.

Concurrently the relative abundance of any asbestos material, other fibers, fillers and binders is determined. Quantities reported are estimates based on areal coverage and thickness of the various speciēs present. Reference samples of varied and known concentrations are used to help establish area percents of fibrous components present in each sample. However, point counting may be conducted on difficult samples or when a secondary quantification technique is necessary. The term "trace-1%" means the denoted component is detected but in quantities less than or equal to 1%. Ranges in percentages may be reported when sample inhomogeneity prevents the determination of more precise value. Identification of non-asbestos material is not as rigorous, as these are not the species of primary interest.

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PHOTOMICROGRAPHS

Also attached are representative photomicrographs of each sample and a compendium of the materials found. The micrographs are taken with crossed polars and a first order red compensator which results in the pink background and shows birefringence as bright colors other than the background and isotropic transparent material as the same color as the background. A short pamphlet which gives a more detailed description and explanation of the features of photomicrography via polarized light microscopy is available at your request.

SAMPLE RETENTION

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:'d CRA

MAR 12 1991

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT

PARTICLE DATA LABORATORIES, LTD.

CLIENT: Conestoga-Rovers & Associates

PDL PROJECT: 17010

PDL LOG NUMBER	SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	ASBESTOS-FORM MATERIAL (%) CHRYSOTILE	AMOSITE	OTHER	NON ASBESTOS-FORM MATERIAL (%) CELLULOSE	FIBROUS GLASS	OTHER FIBERS
18953-B	S2980-022091-SJ-037	Homogeneous Buff Fibrous	1-3	--	--	Trace-1	Trace-1	Wollastonite/ 20 Hair/20-40
18954-B	S2980-022091-SJ-038	Homogeneous Tan Slightly Fibrous	1-3	--	Croc./ TR-1	--	Trace-1	--
18955-B	S2980-022091-SJ-039	Heterogeneous Buff/Gray Slightly Fibrous	3-5	--	--	Trace-1	Trace-1	Wollastonite/ TR-1
18956-B	S2980-022191-SJ-040	Heterogeneous Buff/Gray Slightly Fibrous	3-5	--	Croc./ 1-3	Trace-1	Trace-1	--
---	---	---	--	--	--	--	--	--

ABBREVIATIONS:

CROC.-CROCIDOLITE | TREM.-TREMOLITE | SYNTH.-SYNTHETIC FIBERS

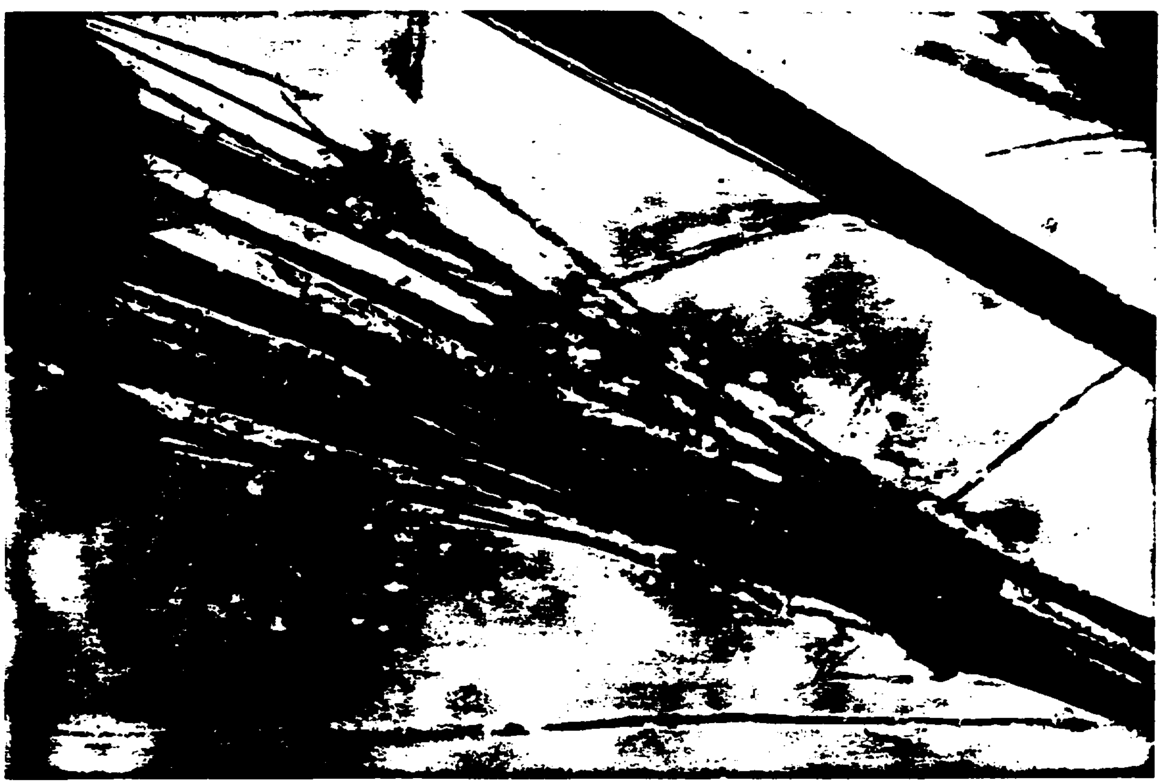
ANTH.-ANTHOPHYLLITE | ACTIN.-ACTINOLITE | CaSil-CALCIUM SILICATES

COMMENTS: ______

MICROSCOPIST: John Aschbacher

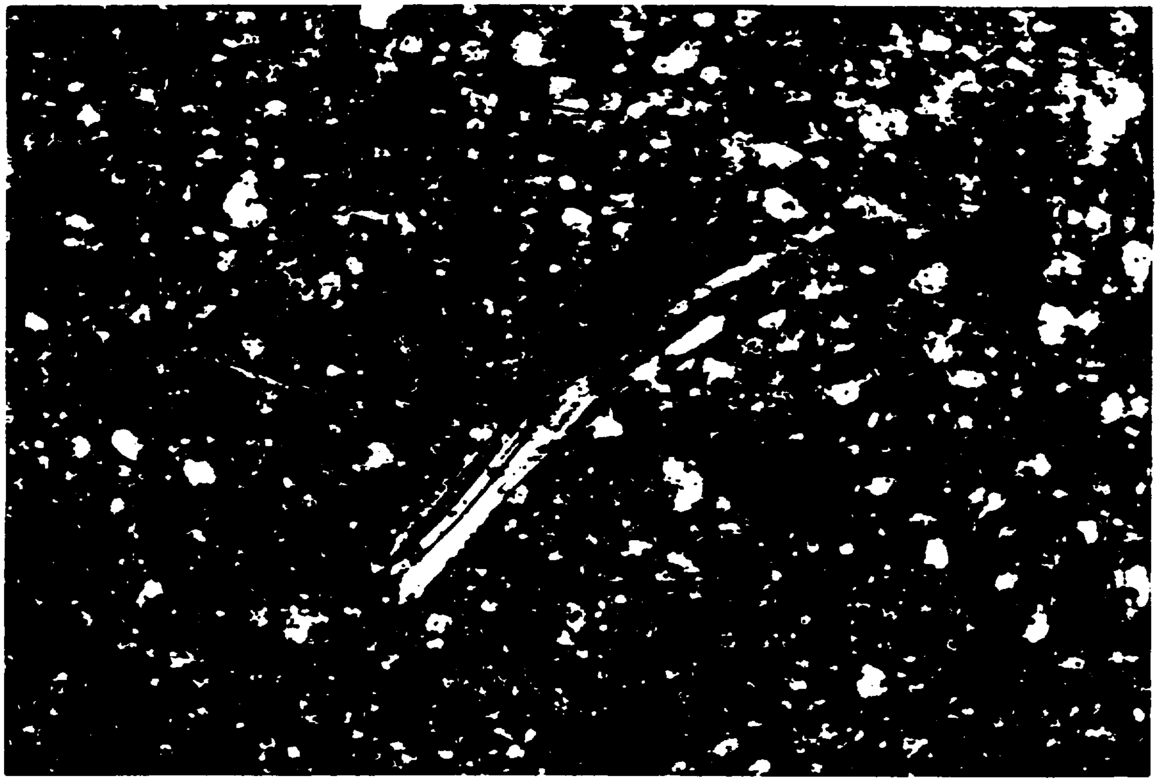
ANALYSIS DATE: 2/26/91

Magnification 100X Sample 18955-B

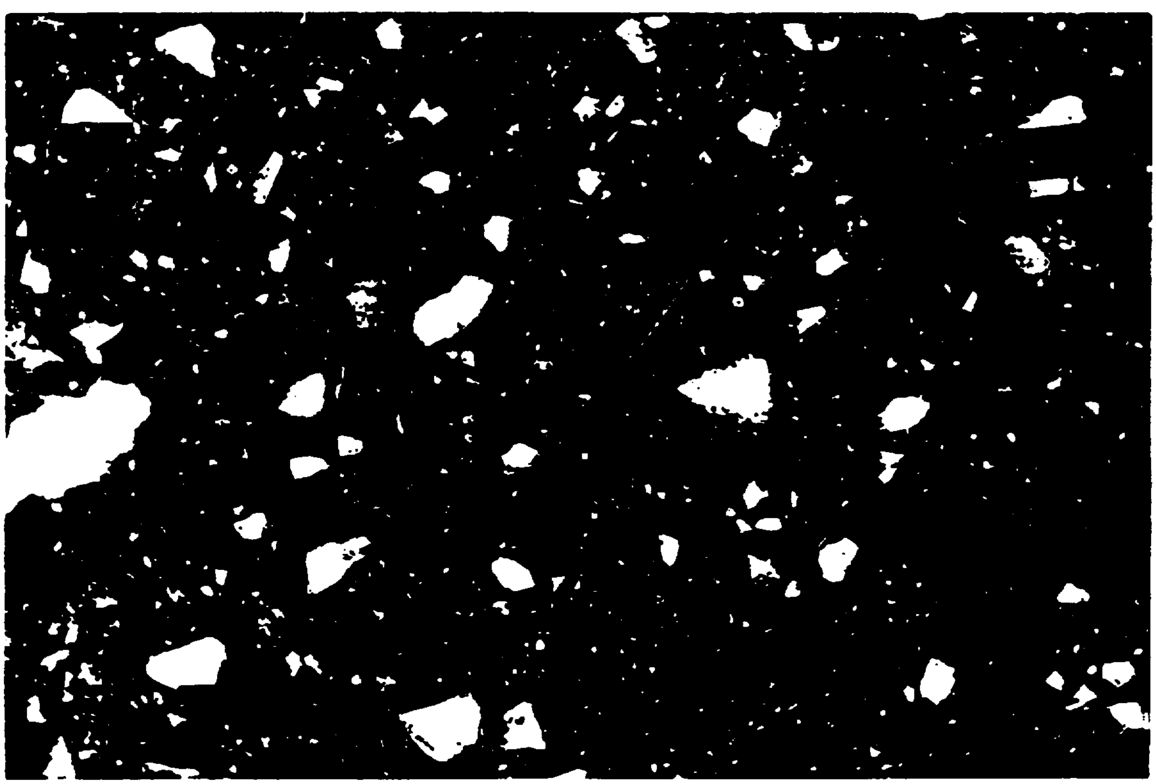


Magnification 100X Sample 18956-B

PARTICLE DATA LABORATORIES, LTD. PDL Project: 17010



Magnification 100X Sample 18953-B



Magnification 100X Sample 18954-B

17010

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): Particle Data Labs

CHAIN OF CUSTODY RECORD

PROJECT Nº: 2980

PROJECT NAME: Manville Disposal Area

SAMPLER'S SIGNATURE ______ (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE ~~LOCATOIN~~ ID	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
1	—	2-20-91	1500	S2980-022091-SS-037	Bulk	1	Bulk Asbestos
2	—	2-20-91	1503	-038	Bulk	1	Bulk Asbestos
3	—	2-20-91	1506	-039	Bulk	1	Bulk Asbestos
4	—	2-21-91	1430	S2980-022191-SS-040	Bulk	1	Bulk Asbestos
				TOTAL NUMBER OF CONTAINERS		~~3~~ 4	

ANTICIPATED CHEMICAL HAZARDS:

RELINQUISHED BY:	DATE/TIME	RECEIVED BY:
1 (SIGN)	2-21-91	2 (SIGN)
2 (SIGN)		3 (SIGN)
3 (SIGN)		4 (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT:	SHIPPED BY:	RECEIVED FOR LABORATORY BY:	DATE/TIME
Fed Express	S. Jung	(SIGN) Mark Smitek	2-22 9:30

CONDITION OF SEAL UPON RECEIPT:	COOLER OPENED BY:	DATE/TIME
GENERAL CONDITION OF COOLER:	(SIGN)	

WHITE – CRA OFFICE COPY
YELLOW – RECEIVING LABORATORY COPY
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PARTICLE DATA LABORATORIES, LTD.

115 Hahn Street • Elmhurst, Illinois 60126 • (708) 832-5658

Rec'd CRA

JUN 13 1991

June 12, 1991

Therese Dorigan
Conestoga-Rovers and Associates, Inc.
10400 W. Higgins Rd. Suite 103
Rosemont, IL. 60018

RE: Examination of Bulk Samples for Asbestos
P.O. Number: 2980
Location: Manville Remediation Site
PDL Project: 17211
EPA Lab I.D. Number 5118

Dear Mrs. Dorigan,

The following report consists of asbestos identification by polarized light microscopy of the samples received 5-28-91.

The samples were not collected by Particle Data personnel.

It has been a pleasure serving you, and we look forward to serving you again in the near future. If you have any questions concerning this report, please do not hesitate to call us at Particle Data Laboratories, Ltd.

Respectfully submitted,

PARTICLE DATA LABORATORIES, LTD.

Parvaneh Shakki

Parvaneh Shakki
Microscopist

ENCLOSURES

PARTICLE DATA LABORATORIES, LTD.

DETERMINATION OF ASBESTOS IN SOIL SAMPLES VIA PLM

Included in the group of samples presented to Particle Data Laboratories for asbestos analysis are soil samples. Soil samples are not analyzed in the same manner as normal bulk insulation samples. The following is a brief description of the methods and deviations necessary for the analysis of these types of samples.

Purpose and Restrictions - Polarized light microscopy (PLM) is a relatively quick and inexpensive method of determining the identity and quantity of fibrous material in soil samples. It is the standard test method used for evaluating asbestos content in insulation and building materials. PLM techniques work well in determining "gross" contamination of asbestos in soils, but may become unreliable if the asbestos fibers are very fine, generally less than 5 microns. Because of this limitation, and the likelihood that weathering mechanism such as rain and abrasion have caused the breakdown of asbestos fibers into very fine fibrils, the EPA has suggested that soils be analyzed via electron microscopy (EM). Electron microscopy provides higher magnification capabilities and better resolution, but costs may be ten times that of optical techniques. Due to the cost prohibitive nature of many environmental surveys, PLM techniques are used as preliminary indicators of gross contamination, usually followed by electron microscopy work on select samples showing little or no asbestos content. In submitting a soil sample the client further recognizes the limited capabilities of the PLM method.

Analysis - The analysis of a soil sample via polarized light microscopy generally follows the techniques used in the analysis of bulk insulation samples. Presently there is not a government/agency issued method which directly deals with the analysis of soil samples via polarized light microscopy techniques. The method used at Particle Data Laboratories is structured around the U.S. Environmental Protection Agency's "Interim Method for the Determination of Asbestos in Bulk Insulation Samples," 40 CFR Part 763, Subpart F, Appendix A, 1987. Though this method is designed for the analysis of friable building materials, most of the steps used in this method are included in the analysis of soil samples, with a few deviations.

The soil sample is first examined in the state it has been received, noting the amount of sample received, if the sample is wet or dry, and the homogeneity of the sample. Typically only 100 to 200 grams of soil is necessary for analysis. In the event that more is given, the sample is split, 100 to 200 grams are retained, and the remaining soil is stored, for future EM analysis

or return to client. Care is taken to subdivide the sample correctly. If the sample is heterogeneous, or "non-uniform" in composition, each subcomponent must be represented in proportion in the split. If the sample is wet then the split sample is dried on a heating pad or in an oven. When dried the split portion is broken down and ground to a fine powder using a mortar and pestal.

Any gravel, large stones, or pieces of insulation or building materials are not ground with the soil but still retained in the split and included in the analysis. At this point the sample is ready for preparation.

A soil sample is initially examined macroscopically using a stereo-microscope and probing tools. Estimations of asbestos content, as well as other fibrous components, are recorded in a laboratory workbook and any suspect fibers are picked out of the soil, mounted on a 1"X3" glass slide and immersed in an appropriate refractive index liquid for the determination of refractive indices via dispersion staining or Becke line techniques, and microscopical characterization. If pieces of insulation or building material are found in the soil, large fibers of asbestos may be present and easily identified. However, most soil samples do not contain such material and require gross preparation of the soil. This is done by placing "pinch" quantities of soil in immersion oil on a glass slide, mixing, and capping with a coverslip. Typically, eight to ten 22mm X 22mm preps are made for each sample. From here, the interim method is applied and fibrous component identification and quantification is determined.

The parameters determined for suspect fibers include: anisotropy, sign of elongation, morphology, extinction angles, pleochroism, color and refractive indices, when possible. Magnification factors of 100 to 400X are typically used in soil sample examination. Refer to the Asbestos Characterization section of the main explanation sheets for feature descriptions for the six common asbestos minerals.

Quantification - Quantification of the asbestos materials present in a soil sample are typically estimations based on areal coverage and thickness determinations and are given in volume percents. Due to the possible presence of sub-micron sized asbestos fibers, finer than the resolution limits of the polarized light microscope and thus unseen during analysis, this analysis only is valid for particles larger than 5 microns in size and a minimum detection limit of 1% is established.

Sample Retention - Soil sample analysis is a destructive test. The material prepared on slides are typically saved for two weeks, then disposed of as asbestos trash. However, there is always soil left which is saved for future re-analysis by TEM, if requested. The sample(s) will be retained for six months unless otherwise instructed.

PARTICLE DATA LABORATORIES, LTD.

SOIL SAMPLE ANALYSIS FOR ASBESTOS CONTENT

Client: Conestoga-Rovers & Associates, Inc.

Date: 5-30-91

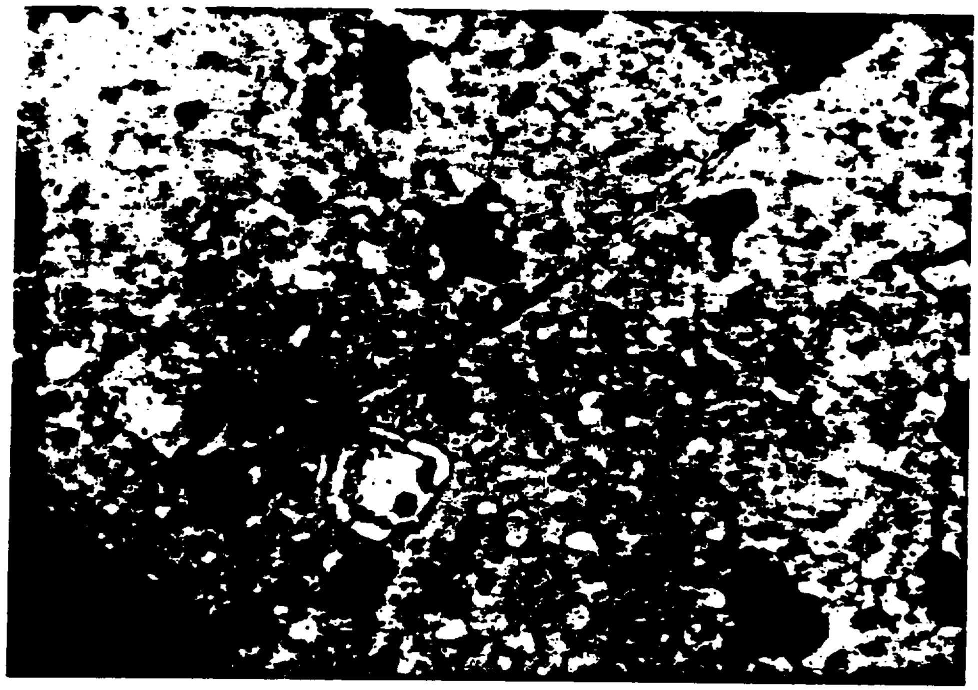
PDL Project: 17211

Analyst: Parvaneh Shakki

PDL LOG NUMBER	SAMPLE IDENTIFICATION	ASBESTOS-FORM MATERIAL *	----NON ASBESTOS-FORM MATERIAL*----- Cellulose	Fibrous Glass	Other Fibers
19716-B	Sj-041 Soil Sample	Chrysotile/5-10	3-5	1-3	---

* = Percent by volume

** = No observed asbestos events for particles > 5 microns.



Magnification 100X Sample 19716-B

MAY 2[illegible] 1991 17211

CRA

CONESTOGA-ROVERS & ASSOCIATES, INC.
10400 West Higgins Road - Suite 103
Rosemont, IL 60018 708/299-9933

SHIPPED TO (Laboratory Name): [illegible]

CHAIN OF CUSTODY RECORD

PROJECT NO. 2980

PROJECT NAME: [illegible]

SAMPLER'S SIGNATURE [illegible] (Sign)

SEQ. NO.	SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	SAMPLE TYPE	NO. OF CONTAINERS	REQUIRED ANALYSES
	S-2980-05[illegible]-041						
		[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]
							[illegible]
			TOTAL NUMBER OF CONTAINERS		1	

ANTICIPATED CHEMICAL HAZARDS

RELINQUISHED BY: 1 [illegible] (Sign)	DATE/TIME 5-[illegible]-91	RECEIVED BY: 2 (Sign)	DATE/TIME
RELINQUISHED BY: 2 (Sign)	DATE/TIME	RECEIVED BY: 3 (Sign)	DATE/TIME
RELINQUISHED BY: 3 (Sign)	DATE/TIME	RECEIVED BY: 4 (Sign)	DATE/TIME
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		SAMPLE TEAM	
METHOD OF SHIPMENT: AIR BILL NO.	SHIPPED BY:	RECEIVED FOR LABORATORY BY: (Sign)	DATE/TIME
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (Sign)	DATE/TIME

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Pink - Sampler Copy
Goldenrod - Shipper Copy

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115 Hahn Street • Elmhurst, Illinois 60126 • (708) 832-5658

Rec'd CRA

JUN 13 1991

June 12, 1991

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PDL Project: 17211

Date: 5-30-91

Analyst: Parvaneh Shakki

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* = Percent by volume

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MAY [illegible] 1991 17211

CRA
CONESTOGA-ROVERS & ASSOCIATES, INC.
10400 West Higgins Road - Suite 103
Rosemont, IL 60018 708/299-9933

SHIPPED TO (Laboratory Name): [illegible]

CHAIN OF CUSTODY RECORD

PROJECT NO. 2930

PROJECT NAME: [illegible]

SAMPLER'S SIGNATURE [illegible] (Sign)

SEQ. NO.	SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	SAMPLE TYPE	NO. OF CONTAINERS	REQUIRED ANALYSES
1	S2980-052891-SJ-041						
		5-28-91	0830	[illegible]	[illegible]	1	[illegible]
							PLM
				TOTAL NUMBER OF CONTAINERS			

ANTICIPATED CHEMICAL HAZARDS

RELINQUISHED BY: 1 [illegible] (Sign)	DATE/TIME 5-29-91	RECEIVED BY: 2 (Sign)	DATE/TIME
RELINQUISHED BY: 2 (Sign)	DATE/TIME	RECEIVED BY: 3 (Sign)	DATE/TIME
RELINQUISHED BY: 3 (Sign)	DATE/TIME	RECEIVED BY: 4 (Sign)	DATE/TIME

ADDITIONAL SIGNATURE SHEET REQUIRED ☐

SAMPLE TEAM

METHOD OF SHIPMENT:
AIR BILL NO.

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RECEIVED FOR LABORATORY BY: (Sign) | DATE/TIME

CONDITION OF SEAL UPON RECEIPT:
GENERAL CONDITION OF COOLER:

COOLER OPENED BY: (Sign) | DATE/TIME

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Yellow - Receiving Laboratory Copy
Pink - Sampler Copy
Goldenrod - Shipper Copy

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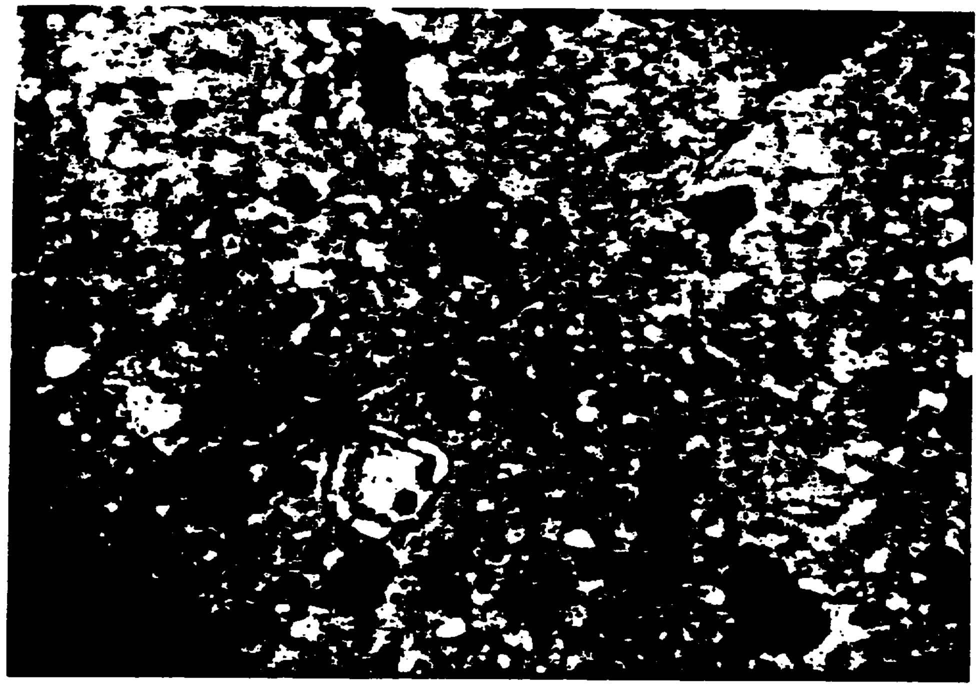

Magnification 100X Sample 19716-B

APPENDIX O

QUALITY ASSURANCE PROJECT PLAN

ATTACHMENT C

QUALITY ASSURANCE PROJECT PLAN

FOR

REMEDIAL ACTION

AT

JOHNS-MANVILLE DISPOSAL AREA
MANVILLE SALES CORPORATION
WAUKEGAN, ILLINOIS

JUNE 1988

(Revised September, 1988)

JOHNSON & MALHOTRA, P.C.
ENVIRONMENTAL ENGINEERS

GRAND RAPIDS, MICHIGAN

ATTACHMENT C

QUALITY ASSURANCE PROJECT PLAN

ATTACHMENT C-1

QUALITY ASSURANCE PROJECT PLAN - 1

FOR

SAMPLING AND MONITORING OF
SOIL COVER, ACTIVE WASTE DISPOSAL AREA,
GROUNDWATER AND SURFACE WATER

QUALITY ASSURANCE PROJECT PLAN - 1

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QUALITY ASSURANCE PROJECT PLAN - 1

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP-1) presents the organization, objectives, functional activities, quality assurance (QA) and quality control (QC) activities associated with certain aspects of Remedial Action being implemented at the Johns-Manville Waste Disposal Area in Waukegan, Illinois. The QAPP is designed to achieve the specific goals of certain remedial activities presented below by describing minimum procedures to assure that the precision, accuracy, sensitivity, completeness, and representativeness of the collected data are known and documented. Enclosed as appendices are four documents:

C1-A: Soil Cover Monitoring Plan
C1-B: Active Waste Disposal Areas Sampling Plan
C1-C: Groundwater and Surface Water Monitoring Program
C1-D: Sampling Quantities, Containers and Preservatives

Preparation of this plan, in general, is in accordance with the following guidance document:

- U.S. EPA, February 1983, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80.

2.0 PROJECT DESCRIPTION

The primary objective of Remedial Action at the Johns-Manville Disposal Area is to protect human health and the environment at the site, through a program designed to control the release of hazardous substances, pollution or contaminants into the environment. All tasks and sub-tasks are directed toward accomplishment of this primary objective.

2.1 Background

Pursuant to a Consent Decree signed by Manville on December 31, 1987, Manville will undertake Remedial Action consisting of a soil cover over the asbestos containing areas, and long term monitoring of groundwater, surface water, soil cover and air to detect any releases of contaminants (notably asbestos, lead and chromium) to the environment. Also included is sampling of active waste disposal areas to confirm that no asbestos is present in the exposed wastes and no hazardous substances are entering the process wastewater treatment basins.

2.2 Objectives and Use of Data

The objectives of sampling/monitoring activities described in this QAPP are 1) to detect specified contaminants in surface water or groundwater, 2) to detect asbestos-containing wastes at or near the surface of the established soil cover and 3) to detect any hazardous contaminants in the active waste disposal areas. Water and soil cover monitoring will continue in accordance with the required SARA 5-year review scenario while active wastes will be sampled once with the exception of the wastewater treatment system, which will be sampled after each significant process change.

The data obtained will be used for purposes specified in the Consent Decree.

2.3 Sampling Schedule

The schedule for the sampling/monitoring activities is presented in Figure 2 of the Work Plan. The parameters for which groundwater, surface water, soil cover and active waste disposal areas will be monitored or tested are presented in Table C1-1.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Illustrated below is the project organization and line of authority for the field investigation. Both project technical management personnel and quality assurance personnel are indicated.

3.1 Organization

Project organization for field sampling/monitoring is presented in Figure C1-1.

3.2 Responsibilities

Overall project supervision and coordination will be the responsibility of Manville Project Coordinator. He will be responsible for accomplishing the tasks as per the directives of "Consent Decree", as well as interacting with and reporting to U.S. EPA and Illinois EPA (IEPA).

All project functional responsibilities lie with the Manville Remedial Construction Manager (RCM). He will be responsible for overseeing project tasks and ensuring their accomplishment. He will be responsible for reporting the project progress to the Manville Project Coordinator and interacting with U.S. EPA and IEPA on an as-needed basis.

Overall coordination of on-site sampling/monitoring activities will be the primary responsibility of the Contractor/Consultant Site Manager. An independent Quality Assurance Monitor will be responsible for reviewing project documents and reports with respect to their conformance to the quality assurance objectives.

TABLE C1-1

MONITORING PARAMETERS

1. Groundwater, Surface Water Monitoring

Asbestos
Chromium (total)
Lead
Arsenic (total)
Phenols
Antimony
Aluminum
Volatile Organics
Semi-volatile organics
PCBs
PBBs
pH)
Specific Conductance) under field conditions
Temperature)

2. Soil Cover Monitoring

Visual for asbestos-containing wastes and vegetative cover
soil borings - asbestos

3. Active Waste Disposal Areas Testing

Matrix	Parameter
Sludge (Sludge Disposal Pit)	Asbestos
Miscellaneous waste (Misc. Disposal Pit)	Asbestos
Process wastewater (influent)	Same as for ground water and surface water (excluding field measurements for pH, temperature, specific conductance and asbestos)

Project Organization

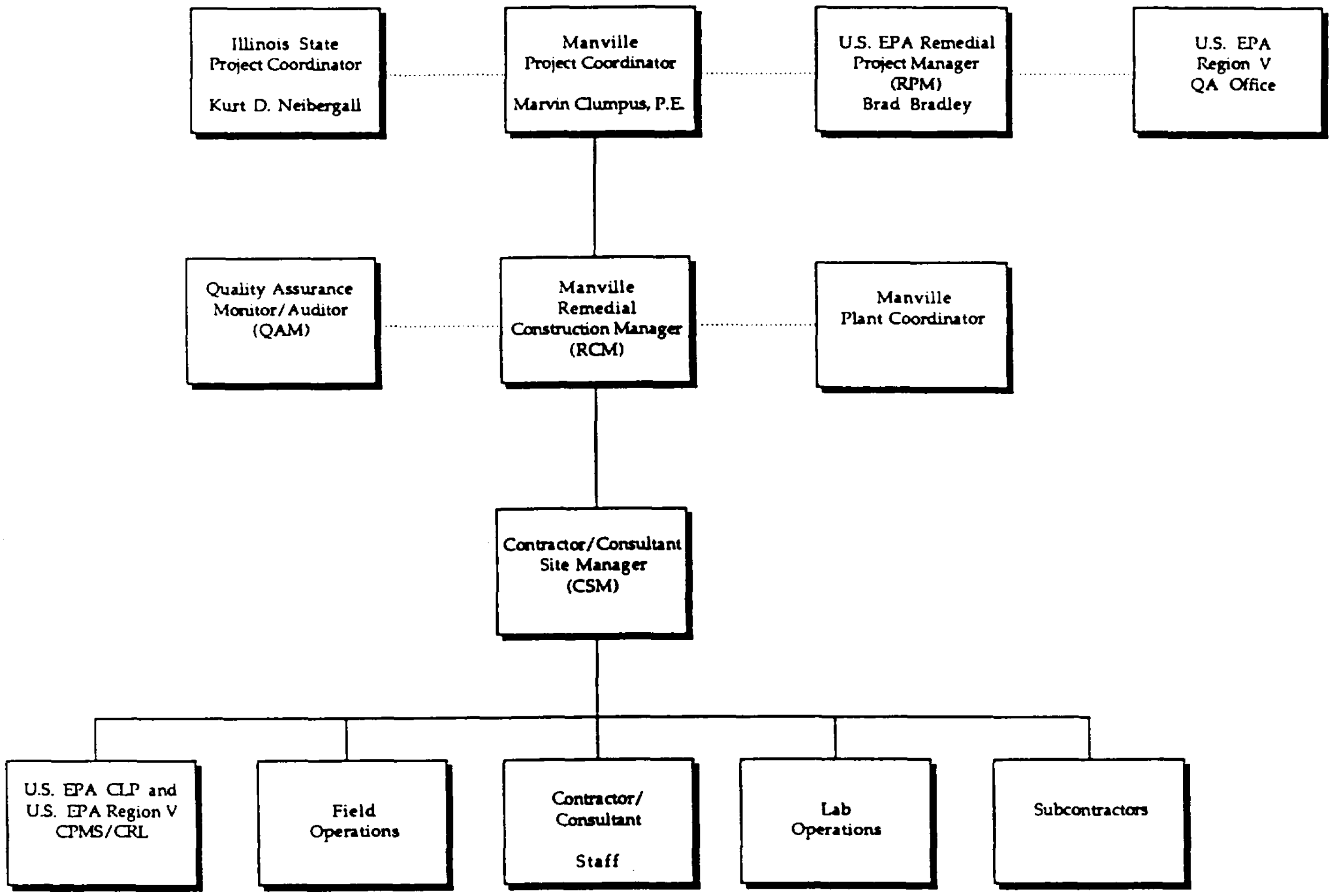


Figure C1-1

A contractor/laboratory will be identified for field sampling and measurement and data assessment. The following laboratories will be used for sample analysis:

1.) <u>Asbestos</u>

Clayton Environmental Consultants
22345 Roethel Drive
Novi, MI 48052
(313)344-1770

or

E.M.S. Laboratories, Inc.
507 Mission St.
South Pasadena, CA 91030
(818)441-7054

2.) <u>Organics including PBB</u>

Clayton Environmental Consultants
22345 Roethel Drive
Novi, MI 48052
(313)344-1770
(currently in CLP)

3.) <u>Inorganics</u>

Vegas Analytical Laboratories
3894 Schiff Drive
Las Vegas, Nevada 89103
(701)365-1201
(currently in CLP)

The groundwater monitoring wells will be approved by U.S. EPA/IEPA representatives in the field. U.S. EPA/IEPA representatives will be notified in advance of all sampling activities.

U.S. EPA CLP and Region V CRL may be involved in the collection and analysis of split samples. U.S. EPA Region V Quality Assurance Office will be one of the parties involved during the entire project, as shown in Figure C1-1.

4.0 QA OBJECTIVES FOR DATA MEASUREMENTS

The overall QA objective is to develop and implement procedures for sampling/monitoring, laboratory analyses, field measurements and reporting that will provide data to a degree of quality consistent with its intended use. This section defines the goals for levels of QC effort; and the accuracy, precision, sensitivity, completeness, representativeness and comparability of laboratory analyses.

4.1 Level of QC Effort

Field duplicate, field blanks and trip blanks (methods and locations described in the Sampling Plans) will be taken and submitted to the analytical laboratory to provide means to assess the quality of the data resulting from the field sampling program. Field duplicate samples will be analyzed to check for sampling and analytical reproducibility. Field blank samples will be analyzed to check for procedural contamination of samples. The general level of this QC effort will be one field duplicate and one field blank for every 10 or less investigative groundwater or surface water samples. One field duplicate sample of soil and sludge will be collected for every 10 or less investigative samples, but field blanks are not required. Two trip blanks (for water VOA only) will be included with each VOA shipping package to the laboratory to check sample contamination during shipping, if any.

The level of QC effort provided by the laboratory will be equivalent to the level of QC effort specified under the CLP program, for the Routine Analytical Services (RAS) parameters to be tested. The level of QC effort for testing of inorganics (metals) will conform to the procedures in the CLP Statement of Work (SOW) for Inorganic Analysis, SOW-7-87-Inorganic. The level of QC effort for testing of Hazardous Substance List (HSL) organics (volatiles, semi-volatiles and PCBs) will conform to the procedures in the CLP Statement of Work (SOW) for Organic Analysis, SOW-7-87-Organic. The level of laboratory QC effort for PBBs testing will be similar to that of PCBs testing. The laboratory QC effort for asbestos will include lab blanks and calibration standard checks for every 10 or less samples as outlined in the "Interim Method for Determining Asbestos in Water", EPA-600-4-80-005. The level of QC effort for analytical testing is provided in Table C1-2.

All instruments used in the field for collection of field measurements will be calibrated daily according to their standard operating procedures. The QC level of effort for the field measurement of pH will consist of pre-measurement calibration. QC effort for field conductivity measurements will include daily

Table C1-2
QC Level of Effort for Analytical Testing

Parameters	Audit	Frequency
Metals	Calibration Blank (ICP and AA and Cold Vapor)	Each calibration beginning and end of each run, 10% frequency
	Initial Calibration Verification (ICP and AA and Cold Vapor	Daily and each instrument setup
	Continuing Calibration Verification (ICP and AA and and Cold Vapor)	Beginning and end of each run; 10% frequency or every 2 hrs, whichever is more frequent
	Preparation Blank (ICP and AA and Cold Vapor)	One per batch or one per 20 samples received, whichever is more frequent
	Matrix Spike Analysis (ICP and AA and Cold Vapor)	One per case or one per 20 samples received, whichever is more frequent
	Duplicate Sample Analysis (ICP and AA and Cold Vapor)	One per case or one per 20 samples received, whichever is more frequent
	Laboratory QC Sample Analysis (ICP and AA and Cold Vapor)	One per batch or one per 20 samples received, whichever is more frequent
	Duplicate Injections (AA-Furnace)	Each sample
	Interference Check Sample (ICP)	Beginning and end of each run or two per 8-hr shift, whichever is more frequent
	Serial Dilution Analysis (ICP)	One per case or one per 20 samples received, whichever is more frequent
	Preparation Blank Spike (AA-Furnace)	One per batch or 20 samples received, whichever is more frequent
	Analytical matrix spike (AA-Furnace)	Each sample

Table C1-2 (continued)

Parameters	Audit	Frequency
	Analytical matrix spike (AA-Furnace)	Each sample
Volatile Organics	Laboratory Blank	One per case or one per 20 samples received, whichever is more frequent
	Matrix Spike/Matrix Spike Duplicate Analysis	One per case or one per 20 samples received, whichever is more frequent
	Surrogate Spike Analysis	Each sample
	Continuous Calibration Check	After the initial calibration; daily before analysis of samples and/or every 8-hr shift
PBBs and PCBs	Laboratory Blank	One per case or one per 20 samples received, whichever is more frequent
	Matrix Spike	One per case or one per 20 samples received, whichever is more frequent
	Continuous Calibration Check	After the initial calibration; daily before analysis of samples and/or every 8-hour shift
Asbestos	Calibration Blank (Standard)	One per 8-hour shift or one for every 10 samples
	Laboratory Blank	One for every 10 or less samples
	Duplicate Sample Analysis	One for every 10 or less samples

calibration of the instrument using a standard solution of known conductivity.

4.2. Accuracy, Precision and Sensitivity of Analysis

The QA objective with respect to accuracy, precision and sensitivity of laboratory analytical methods is to achieve the QC acceptance criteria of the analytical protocols. The accuracy, precision and sensitivity requirements for testing of all parameters will be equivalent to those specified under the CLP and "Interim Method for Determination of Asbestos in Water", EPA-600-4-80-005 (Anderson and Long Method) and "Interim method for determination of Asbestos in Bulk Insulation Samples", EPA, Dec. 1982.

The requirements for testing of inorganics (metals) will be in accordance with SOW-7-87-Inorganics. The requirements for testing of HSL organics (volatiles, semi-volatiles and PCBs) will be in accordance with SOW-7-87-Organics. The sensitivity required for the parameters to be tested are the detection limits shown in Table C1-3. The accuracy and precision criteria for the parameters to be tested are shown on Table C1-4.

Table C1-3
Target Compound List (TCL) and
Required Detection Limits (RDL)*

	VOLATILES	CAS Number	Detection Limits** Water ug/L	Low Soil/Sediment[a] ug/Kg
1.	Chloromethane	74-87-3	10	10
2.	Bromomethane	74-83-9	10	10
3.	Vinyl Chloride	75-01-4	10	10
4.	Chloroethane	75-00-3	10	10
5.	Methylene Chloride	75-09-2	5	5
6.	Acetone	67-64-1	10	10
7.	Carbon Disulfide	75-15-0	5	5
8.	1,1-Dichlorethane	75-35-4	5	5
9.	1,1-Dichloroethene	75-34-3	5	5
10.	1,2-Dichloroethene (total)	550-59-0	5	5
11.	Chloroform	67-66-3	5	5
12.	1,2-Dichloroethane	107-06-2	5	5
13.	2-Butanone	78-93-3	10	10
14.	1,1,1-Trichloroethane	71-55-6	5	5
15.	Carbon Tetrachloride	56-23-5	5	5
16.	Vinyl Acetate	108-05-4	10	10
17.	Bromodichloromethane	75-27-4	5	5
18.	1,2-Dichloropropane	78-87-5	5	5
19.	cis-1,3-Dichloropropene	10061-01-5	5	5
20.	Trichloroethene	79-01-6	5	5
21.	Dibromochloromethane	124-48-1	5	5
22.	1,1,2-Trichloroethane	79-00-5	5	5
23.	Benzene	71-43-2	5	5
24.	trans-1-3-Dichloropropene	10061-02-6		
25.	Bromoform	75-25-2	5	5
26.	4-Methyl-2-pentanone	108-10-1	10	10
27.	2-Hexanone	591-78-6	10	10
28.	Tetracloroethene	127-18-4	5	5
29.	Toluene	108-88-3	5	5
30.	1,1,2,2-Tetrachloroethane	79-34-5	5	5
31.	Chlorobenzene	108-90-7	5	5
32.	Ethyl Benzene	100-41-4	5	5
33.	Styrene	100-42-5	5	5
34.	Xylenes (Total)	1330-20-7	5	5
35.	Phenol	108-95-2	10	330
36.	bis(2-Chloroethyl) ether	111-44-4	10	330
37.	2-Chlorophenol	95-57-8	10	330
38	1,3-Dichlorobenzene	541-73-1	10	330
39.	1,4-Dichlorobenzene	106-46-7	10	330

Table C1-3 (continued)
Target Compound List (TCL) and
Required Detection Limits (RDL)*

	SEMI-VOLATILES	CAS Number	Detection Limits** Water ug/L	Low Soil/Sediment[a] ug/Kg
40.	Benzyl alcohol	100-51-6	10	330
41.	1,2-Dichlorobenzene	95-50-1	10	330
42.	2-Methylphenol	95-48-7	10	330
43.	bis(2-Chloroisopropyl) ether	108-60-1	10	330
44.	4-Methylphenol	106-44-5	10	330
45.	N-Nitroso-di-n-dipropylamine	621-64-7	10	330
46.	Hexachloroethane	67-72-1	10	330
47.	Nitrobenzene	98-95-3	10	330
48.	Isophorone	78-59-1	10	330
49.	2-Nitrophenol	88-75-5	10	330
50.	2,4-Dimethylphenol	105-67-9	10	330
51.	Benzoic acid	65-85-0	50	1600
52.	bis(2-Chloroethoxy) methane	111-19-1	10	330
53.	2,4-Dichlorophenol	120-83-2	10	330
54.	1,2,3-Trichlorobenzene	120-82-1	10	330
55.	Naphthalene	91-20-3	10	330
56.	4-Chloroaniline	106-47-8	10	330
57.	Hexachlorobutadiene	87-68-3	10	330
58.	4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59.	2-Methylnaphthalene	91-57-6	10	330
60.	Hexachlorocyclopentadiene	77-47-4	10	330
61.	2,4,6-Trichlorophenol	88-06-2	10	330
62.	2,4,5-Trichlorophenol	95-95-4	50	1600
63.	2-Chloronaphthalene	91-58-7	10	330
64.	2,Nitroaniline	88-74-4	50	1600
65.	Dimethylphthalate	131-11-3	10	330
66.	Acenaphthylene	208-96-8	10	330
67.	2,6-Dinitrotoluene	606-20-2	10	330
68.	3-Nitroaniline	99-09-2	50	1600
69.	Acenaphthene	83-32-9	10	330
70.	2,4-Dinitrophenol	51-28-5	50	1600
71	4-Nitrophenol	100-02-7	50	1600
72.	Dibenzofuran	132-64-9	10	330
73.	2,4-Dinitrotoluene	121-14-2	10	330
74.	Diethylphthalate	84-66-2	10	330

Table C1-3 (continued)
Target Compound List (TCL) and
Required Detection Limits (RDL)*

	SEMI-VOLATILES	CAS Number	Detection Limits** Water ug/L	Low Soil/Sediment[a] ug/Kg
75.	4-Chlorophenyl-phenyl ether	7005-72-3	10	330
76.	Fluorene	86-73-7	10	330
77.	4-Nitroaniline	100-01-6	50	1600
78.	4-6-Dinitro-2-methylphenol	534-52-1	50	1600
79.	N-nitrosodiphenylamine	86-30-6	10	330
80.	4-Bromophenyl-phenylether	101-55-3	10	330
81.	Hexachlorobenzene	118-74-1	10	330
82.	Pentachlorophenol	87-86-5	50	1600
83.	Phenanthrene	85-01-8	10	330
84.	Anthracene	120-12-7	10	330
85.	Di-n-butylphthalate	84-74-2	10	330
86.	Fluroanthene	206-44-0	10	330
87.	Pyrene	129-00-0	10	330
88.	Butylbenzylphthalate	85-68-7	10	330
89.	3,3'-Dichlorobenzidine	91-94-1	20	660
90.	Benzo(a)anthracene	56-55-3	10	330
91.	Chrysene	218-01-9	10	330
92.	Bis(2-Ethylhexyl)phthalate	117-81-7	10	330
93.	Di-n-octylpthalate	117-84-0	10	330
94.	Benzo(b)fluoranthene	205-99-2	10	330
95.	Benzo(k)fluoranthene	207-08-9	10	330
96.	Benzo(a)pyrene	50-32-8	10	330
97.	Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98.	Dibenz(a,H0anthracene	53-70-3	10	330
99.	Benzo(g,h,i)perylene	191-24-2	10	330
	PCBs			
100.	Aroclor-1016	12674-11-2	0.5	80.0
101.	Aroclor-1221	11104-28-2	0.5	80.0
102.	Aroclor-1232	11141-16-5	0.5	80.0
103.	Aroclor-1242	53467-21-9	0.5	80.0
104.	Aroclor-1248	12672-29-6	0.5	80.0
105.	Aroclor-1254	11097-69-1	1.0	160.0
106.	Aroclor-1260	11096-82-5	1.0	160.0
107.	PBBs (hexa bromo biphenyl)	-	0.5	-

Table C1-3 (continued)

Notes:

[a]Medium Soil/Sediment Required Detection Limits (RDL) for Pesticide/PCB. TCL compounds are 15 times the individual Low Soil/Sediment RDL.

*Specific quantitation limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

**Detection limits listed for soil/sediment are based on wet weight. The detection limit calculated by the laboratory for soil/sediment, calculated on dry weight basis will be higher.

TABLE C1-3 (CONTINUED)
INORGANIC TARGET ANALYTE LIST (TAL)

Analyte	Required Detection Limit (1) ug/L
Aluminum	200
Antimony	60
Total Arsenic	10
Total Chromium	10
Asbestos	
Lead	5

(1) Subject to the restrictions specified in SOW-7-87-Inorganics.

Table C1-4
Accuracy and Precision Criteria for Analytical Testing

Method	Audit	Control Units
AA Flame	Calibration Blank	≤D.L.
	Initial Calibration Verification	90-110%
	Continuing Calibration Verification	90-110%
	Preparation Blank	≤D.L.
	Matrix Spike Analysis	75-125%
	Duplicate Sample Analysis	±D.L. or 20% RPD*
	Laboratory QC Sample Analysis	80-120%

*RPD = Relative % Difference

Method	Audit	Control Units
AA-Furnace	Calibration Blank	≤D.L.
	Initial Calibration Verification	90-110%
	Continuing Calibration Verification	90-110%
	Preparation Blank	≤D.L.
	Matrix Spike Analysis	75-125%
	Duplicate Sample Analysis	±D.L. or 20% RPD
	Laboratory QC Sample Analysis	80-120%
	Duplicate Injections	±20% RPD
ICP	Calibration Blank	≤D.L.
	Initial Calibration Verification	90-110%
	Continuing Calibration Verification	90-110%
	Preparation Blank	≤D.L.
	Interference Check Sample	±20%
	Serial Dilution Analysis	±10%
	Matrix Spike Analysis	75-125%
	Duplicate Sample Analysis	±D.L. or 20% RPD
	Laboratory QC Sample Analysis	80-120%
	Duplicate Injections	±20% RPD

Table C1-4 (continued)

SURROGATE SPIKES

Fraction	Surrogate Compound	Recovery Limits Low/Medium Water	Recovery Limits Low/Medium Soil/Sediment
VOA	Toluene-d_8	88-110	81-117
VOA	4-Bromofluorobenzene	86-115	74-121
VOA	1,2-Dichloroethane-d_4	76-114	70-121
BNA	Nitrobenzene-d_5	35-114	23-130
BNA	2-Fluorobiphenyl	43-116	30-115
BNA	p-Terphenyl-d_{14}	33-141	18-137
BNA	Phenol-d_5	10-94	24-113
BNA	2,4,6-Tribromophenol	10-123	19-122

MATRIX SPIKE/MATRIX SPIKE DUPLICATES*

Fraction	Matrix Spike Compound	Recovery Limits Water	RPD Water	Recovery Limits Soil/ Sediment	RPD Soil/ Sediment
VOA	1,1-Dichloroethene	61-145	14	59-172	22
VOA	Trichloroethene	71-120	14	62-137	24
VOA	Chlorobenzene	75-130	13	60-133	21
VOA	Toluene	76-125	13	59-139	21
VOA	Benzene	76-127	11	66-142	21

Fraction	Matrix Spike Compound	Recovery Limits Water	RPD Water	Recovery Limits Soil/ Sediment	RPD Soil/ Sediment
BN	Pyrene	26-117	31	35-142	36
Acid	Phenol	12-89	42	26-90	35
PCBs	)	To be developed by selected contractor/laboratory			
PBBs	Fire Master BP-6)				

*These limits are for advisory purposes only. They will not be used to determine if a sample should be reanalyzed. Spiking levels and procedures will be in accordance with CLP Statement of Work for Organic Analysis, SOW-7-87-Organics.

The accuracy of field measurements of pH will be assessed through pre-measurement calibrations using at least two standard buffer solutions. The two measurements must each be within ± 0.05 standard units of the buffer solution values. Precision will be assessed through replicate measurements. (The electrode will be withdrawn, rinsed with deionized water, and re-immersed between each replicate). The instrument used will be capable of providing measurements to 0.1 standard unit.

4.3. Completeness, Representativeness and Comparability

It is expected that the laboratory will provide data meeting QC acceptance criteria for 95 percent or more of all samples tested. Valid data are required for samples to be used in assessing background concentrations.

The sampling network was designed to satisfy Consent Decree requirements. During development of this network, consideration was given to past site operations and practices, existing analytical data and physical setting and processes. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in this QAPP, are expected to provide comparable data.

4.4. Field Measurements

Measurements and observations will be made in many field activities that are incidental to collecting samples for analytical testing or unrelated to sampling. These activities include, but are not limited to, the following:

- Documenting time and weather conditions,
- Locating and determining the elevation of sampling stations,
- Determining depths in a borehole or well,
- Calculating pumping rates, and
- Verifying well development and pre-sampling purge volumes.

The general QA objective for such measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the intended use of such data through the documented use of standard procedures.

5.0 SAMPLING/MONITORING PROCEDURES

Procedures for sampling/monitoring to be conducted as part of the Remedial Action are described in the following documents presented as Appendices C1-A, C1-B and C1-C.

A. Soil Cover Monitoring Plan

B. Active Waste Disposal Areas Sampling Plan

C. Groundwater and Surface Water Monitoring Program

Procedures for 1) sampling 2) equipment and sampler decontamination, 3) sample numbering, and 4) collecting field blanks and duplicates are specified where appropriate. Also included (in Appendix C1-D) are listings of the type, size and number of sample bottles to be used.

6.0 SAMPLE AND DOCUMENT CUSTODY PROCEDURES

Successful implementation of a sampling or monitoring program depends on the capability to produce valid data and to demonstrate such validity. In addition, proper sample collection, preservation, storage and handling, as well as appropriate sample identification and chain of custody procedures are necessary to help ensure the validity of the data.

Sample custody procedures for this project will be similar to the procedures detailed under "Sample Identification and Custody Procedures" of the User's Guide to the EPA Contract Laboratory Program dated August, 1982. A brief summary is presented in this section.

6.1 Sample Handling, Shipping and Custody

U.S. EPA sample handling, shipping and custody procedures will be followed. The samples will be collected in pre-washed containers. Sample containers, quantities and preservation techniques are presented in Appendix C1-D. Following sampling, the sample containers will be decontaminated. The sample containers will be identified by a sample label. Labels on field blanks and duplicate samples will be marked with an "FB" or "D" suffix, respectively.

A chain of custody will be maintained for each sample collected. The chain of custody will provide an accurate written record which can be used to trace the possession and holding of samples from the time of collection through data analysis and reporting. The following information will be specified for each sample on the sample label and chain of custody form: 1) sequential sample number, 2) sample date, 3) sample time, 4) sample location (and depth where appropriate), and 5) analyses to be performed. The chain of custody form will be signed by each sampling participant. It will be placed in a water tight plastic bag and taped to the underside of the lid of the cooler containing the samples designated on the form. The lid of the cooler will be securely taped shut, utilizing evidence tape to allow detection of any possible tampering. Upon arrival in the laboratory, samples will be checked in by the laboratory representative. All samples contained in the shipment will be compared to the chain of custody form to ensure that all samples designated have been received. Also, record of chain of custody within the laboratory will be maintained.

6.2 Field Documentation

Field log books (also field notebooks) will provide the means of recording data collection activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory. Photographs may be used to supplement field notes where applicable.

Field log books will be bound, field survey notebooks. Log books will be assigned to field personnel, but will be stored in the field project file when not in use. Each log book will be identified by a project specific number. The title page of each notebook will contain: 1) person or organization to whom the book is assigned, 2) book number, 3) project name, 4) start and end dates.

Entries into the log book will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling and/or investigative personnel present, and the signature of the person making the entry will be entered. The names of visitors to the site and the purpose of their visit will be recorded in the field log book.

Measurements and observations made as well as information on samples collected will be recorded. All entries will be made in waterproof ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Wherever a sample is collected or a measurement/observation is made, a detailed description will be recorded. All equipment used to make measurements will be identified.

The equipment used to collect samples will be noted, along with the time of collection, sample description, depth at which sample was collected, volume and number of containers. Sample identification numbers, assigned prior to sample collection, are presented in the Sampling/Monitoring Plans. Duplicates and field blanks, which receive separate sample numbers, will be noted under sample description.

6.3 Project File

A project file will be maintained by the Manville Remedial Construction Manager which will contain complete project documentation. This file will include: project plans and specifications, field logbook and data records, photographs, maps and drawings, sample identification documents, chain of custody records, process and technical reports, correspondence and other information. The file will also contain analytical data provided by the laboratory (Section 9.0): QC documentation, copies of raw data, gas chromatographs, mass spectographs, data validation notes, references and literature, report notes and calculations.

7.0 CALIBRATION CONTROL

Laboratory calibration procedures for testing analytical parameters will be performed in accordance with the CLP Statement of Work. Calibration of instrumentation used in the analyses of inorganics will conform to the procedures in SOW-7-87-Inorganics. Calibration of instrumentation used in the anlayses of HSL organics (volatiles, semi-volatiles, and PCBs) will conform to the procedures in SOW-7-87-Organics. Calibration of instruments for PBBs will be in conformance with the analytical procedure attached in Appendix C1-E.

The field instruments will be calibrated prior to their use. The calibration procedures will follow standard manufacturer's instructions to assure that the equipment is functioning within tolerances established by the manufacturer and analytical requirements. In absence of manufacturer's instructions, a specific calibration and operations instruction sheet will be prepared.

Field calibration procedures will be performed on field instrumentation as follows:

- <u>pH Meter</u> - premeasurement calibration using at least two standard buffer solutions for each sample tested. The buffer solutions should bracket the sample pH. The two measurements must be within $\pm$0.05 standard pH unit of buffer solution values.

- <u>Conductivity Meter</u> - daily calibration using potassium chloride (KCl) standard solution. The meter measurement must read within $\pm$10 percent of the standard solution value.

- <u>Temperature</u> - temperature is measured using a thermostat built into the Conductivity Meter. The readings will be checked at least once at the start of the field use of the instrument using a quality grade thermometer.

8.0 <u>ANALYTICAL PROCEDURES</u>

The analytical methods which will be used to test each parameter in water, sediments and soils are listed in Table C1-5. The analytical procedures for testing the RAS parameters will be in accordance with those specified in the CLP Statements of Work or equivalent. The analytical procedures for testing the inorganics (metals) will conform to those specified in SOW-7-87-Inorganics. The analytical procedures for testing the HSL organics (volatiles, semi-volatiles, and PCBs) will conform to those specified in SOW-7-87-Organics.

The analytical procedure for PBB testing will be the same as for PCBs/Pesticides except that a different column and an Electron Capture Detector will be utilized.

Bulk asbestos in the soil/sediment sludge will be analyzed by the standard Polarized Light Microscopic procedures as outlined in the "Interim Method for Determination of Asbestos in Bulk Insulation Samples", EPA - December, 1982. Asbestos in water samples will be anlayzed by standard Transmission Electron Microscopic procedures as outlined in the "Interim Method for Determining Asbestos in Water", EPA-600-4-80-005.

Table C1-5
Analytical Methods

PARAMETERS	ANALYTICAL METHODS
Metals (1)(2)(3)	ICP 200.7 CLP-M or AA-Flame CLP-M or AA-Furnace CLP-M
Volatile Organic	EPA Method 624 CLP-M (GC/MS)
Semi-Volatile Organics	EPA Method 625 CLP-M (GC/MS)
PCBs/PBB	EPA Method 608 CLP-M (GC with ECD) (Detailed method enclosed)
Asbestos (soil)	PLM Method - EPA - Interim Method
Asbestos (water)	TEM Method - EPA-600-4-80-005

Notes:

(1) Testing for metals will conform to the procedures in Contract Laboratory Program Statement of Work (SOW) for Inorganic Analysis, SOW-7-87-Inorganics.

(2) Preparation of samples for metals testing will conform with the following procedures in SOW-7-87-Organics:

- Furnace Digestion Procedures for Water
- ICP/Flame AA Digestion Procedures for Water
- Sample Preparation of Sediments, Sludges and Soils (acid digestion).

(3) Any analytical method listed in the SOW may be used as long as the documented instrument or method detection limits meet the detection limit requirement shown on Table C1-3. Analytical methods with higher detection lmits may be used only if the sample concentration exceeds twice the documented detection limit of the instrument or method.

9.0 DATA REDUCTION, VALIDATION, REPORTING AND ASSESSMENT

The contractor/analytical laboratory will review appropriate laboratory quality control data to assure the validity of the analytical results provided to the Contractor. "Laboratory Data Validation, Functional Guidelines for Evaluating Organic Analyses", February 1, 1988 and "Laboratory Data Validation", Functional Guidelines for Evaluating Inorganic Analyses, April, 1988 will be used for organic (including PBB) and inorganic analyses data validation, respectively. For asbestos lab blanks, calibration standard, field blanks and duplicate sample results as well as sample integrity, data entry and calculations and sample representativeness will be evaluated during data validation. The analytical laboratory will prepare and retain full analytical and QC documentation.

Analytical laboratory will follow CLP protocols for data reduction and reporting. Data reporting would include raw data on laboratory blanks, calibration checks, chromatograms, surrogate spike recovery data etc. Any deviation from the analytical method shall be reported by the analytical laboratory. Special reporting such as concentrations in soil on a dry or wet weight basis shall be delineated in reporting of the data. All data will be reported in the generally acceptable reporting units.

Data reduction and data reporting for asbestos will be in comformance with "Interim Method for Determining Asbestos in Water", EPA-600-4-80-005 and "Interim Methods for Determination of Asbestos in Bulk Insulation Samples," U.S. EPA, December, 1982.

The analytical laboratory will also provide the following information to the RCM and CSM.

9.1 Test Methods and Results

-analytical test methods and results for submitted samples, field blanks, duplicates and trip blanks (VOA only) with appropriate quality notations, and indication of test methods used.

9.2 Miscellaneous Information

-miscellaneous information, including a statement of samples received, a description of deviations from the QAPP, or explanation of qualifications regarding data quality and other significant items encountered during analysis.

9.3 QA/QC report:

9.3.1 Organic Parameters:

- o surrogate spike results for each sample
- o matrix spike and matrix spike duplicate results
- o method blank results
- o initial calibration verification results
- o continuous calibration check

9.3.2 Inorganic Parameters:

- spike and duplicate results
- method blank results
- initial calibration verification results
- continuous calibration check

9.3.3 Asbestos:

- lab blanks and calibration standard results

9.4 Data Assessment

Each analytical data package submitted will contain items 9.1 through 9.3 above for a discrete set or case of samples analyzed. Where such grouping is not applicable, the analytical laboratory will identify the test results associated with each QC sample.

Data assessment will be accomplished by the joint efforts of the laboratory and the RCM/CSM. The data assessment by the RCM/CSM will be based on the criteria that the sample was properly collected and handled according to the Sampling Plans and Section 6.0 of this QAPP.

The RCM/CSM will conduct a systematic review of the data omissions and interact with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analyses may be made by the RCM/CSM based on the extent of the deficiencies and their importance in the overall context of the project.

All data generated during this project will be stored in the Project File (see Section 6.3).

Following data review, all data generated for the project will be put in a format organized to facilitate data review and evaluation. The data set will include the data flags provided by the laboratory (in accordance with the CLP Statments of Work), as well as additional comments of the data reviewer. The laboratory provided data flags include such items as: 1) concentration below required detection limit, 2) estimated concentrations due to poor spike recovery, and 3) concentrations of chemicals also found in laboratory blank. Additional comments will address if the data is: 1) useable as a quantitative concentration, 2) useable with caution as an estimated concentration, or 3) unuseable due to out-of-control QC results.

10.0 INTERNAL QC CHECKS

Inorganic and organic testing will be performed in accordance with procedures specified in the CLP Statements of Work, SOW-7-87-Inorganics and SOW-7-87-Organics for inorganic and organic analysis respectively.

There are two types of quality assurance used to ensure the production of analytical data of known and documented useable quality: analytical method quality control (QC), and program quality assurance (QA). The internal quality control procedures associated with testing of the parameters have been described in Section 4.0.

It will be the laboratory's responsibility to document, in each data package provided, that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in non-conformance with QC criteria will be reanalyzed by the laboratory when sufficient sample volume is available and the allowed holding time is not exceeded.

11.0 PERFORMANCE AND SYSTEM AUDITS

System audits are performed on a semi-continuous basis as appropriate throughout the duration of the project. The Contractor/Consultant Site Manager (CSM) is responsible for supervising and checking that samples are collected and handled in accordance with the approved project plans and that documentation of field work is adequate and complete. The RCM/CSM is responsible for overseeing that the project performance satisfies the QA objectives, as set out in this QAPP.

Performance audits of laboratories participating in the CLP or approved for CLP-type testing are performed in accordance with the procedures and frequencies established for the CLP by EPA.

The Quality Assurance Auditor is responsible for monitoring and auditing the performance of the QA procedures listed in this plan. He will maintain continuous communication with the RCM/CSM. Also, external audits will be performed by the Contract Project Management Section (CPMS) of Region V, Central Regional Laboratory (CRL).

12.0 PREVENTIVE MAINTENANCE

A routine preventive maintenance program is conducted by the laboratory to minimize the occurrence of instrument failure and other system malfunction. Field instruments will be checked and calibrated prior to their use on-site and batteries will be charged daily, where applicable.

13.0 DATA MEASUREMENT ASSESSMENT PROCEDURES

Data assessment will be accomplished by the joint efforts of the Quality Assurance Auditor and RCM/CSM. The Quality Assurance Auditor will review the analytical results for compliance with the established QC criteria as described in Section 9.0. The data assessment by the RCM/CSM will be based on the criteria that the sample was properly collected and handled in accordance with the Sampling Plans and Section 6.0; and the QA/QC Criteria of Section 9.0 of this QAPP. Any problems arising during sample collection, packing, shipping or analysis will be taken into consideration during the data assessment.

14.0 CORRECTIVE ACTION

Quality control corrective action consists of those corrective actions following a failure to meet quality control criteria specified in this QAPP. Actions taken will consist of two types: those resolved within the analytical laboratory and those resolved outside the laboratory. Examples outlining the differences between these two types of corrective actions are as follows:

WITHIN LABORATORY ACTION:

QC Failure	Department Action
o Tuning results for GC/MS fail criteria	Analyst retunes instrument
o RPD and percent recoveries fail criteria, and sample holding times have not expired	Analyst investigates problem and reruns analyses
o Standard curve correlation coefficient is less than 0.995	Analyst reruns curve

OUTSIDE LABORATORY ACTION:

QC Failure	Department Action
o Holding times are exceeded	Notify QA Auditor resampling may be necessary

The Project QA Auditor along with the RCM/CSM will be responsible for initiating the corrective action. Nonconformance with the established quality control procedures will be identified and controlled. The U.S. EPA Remedial Project Manager will be responsible for approving the corrective action.

15.0 QUALITY ASSURANCE REPORTS

The complete and correct implementation of this QAPP will be reviewed by the RCM/CSM. Any deviations from this QAPP or any concern arising during the project requiring significant changes in the QAPP also will be identified by the RCM/CSM. The RCM/CSM will propose adjustments required to Manville Corporation, Project Coordinator and U.S. EPA, and after approval by U.S. EPA, will ensure their implementation. The QA related information will be contained within the monthly progress reports to U.S. EPA, as applicable. No separate QA reports will be submitted.

16.0 SAMPLING/MONITORING PROGRAMS

The objective of a sampling/monitoring plan is to provide a document detailing procedures and practices to be used during the Remedial Action. Sampling/Monitoring plans for soil cover, groundwater and surface water, and the active waste disposal areas are part of this QAPP and are presented in Appendices C1-A to C1-C.

APPENDIX C1-A

SOIL COVER MONITORING PLAN

SOIL COVER MONITORING PLAN

1.0 INTRODUCTION

As part of the Remedial Action at the Johns-Manville Disposal Area in Waukegan, Illinois, a 24-inch thick soil cover with vegetation will be placed over specified areas. All cover materials will be tested for asbestos prior to placement, and the cover density will be tested in the field, as described in Attachment B of the Amended Work Plan. This Monitoring Plan documents procedures to be followed during the monitoring events.

2.0 MONITORING AND SAMPLING PROCEDURES

2.1 Visual Monitoring

Visual monitoring will begin after completion of the Remedial Construction Work and will consist of two separate visual events each year for a minimum period of thirty (30) years and monitoring requiqrements will be reevaluated at that time. The two annual monitoring events will be:

1. Soil cover monitoring. (Late Spring Monitoring)
2. Vegetative cover monitoring. (Late Fall Monitoring)

The visual monitoring will be conducted during late spring and will involve visual monitoring of the entire surface of the covered waste disposal areas for asbestos-containing waste materials and cave-ins. The vegetative cover monitoring will be conducted during late fall and will involve visual monitoring for bare or eroded surfaces/areas.

The procedure for visual monitoring of soil and vegetative covers will involve walking the entire site and looking for:

1. Asbestos-containing materials on the surface.
2. Cave-ins and ponded areas.
3. Bare spots.
4. Soil-eroded spots.

2.2 Soil Boring

In addition to the visual monitoring as presented above, soil borings will be made to monitor up-migration of asbestos-containing plant (manufacturing) waste material and collect soil samples for bulk asbestos analysis as required. Twenty-four inch (24") deep borings in the soil cover will be made at ten locations. The locations for soil borings will be mutually agreed upon by Manville and U.S. EPA after the soil cover is completed.

The procedure for this monitoring effort will involve hand driving a split spoon to a total depth of 24", and visually inspecting the core in six inch sections for asbestos-containing waste material.

core in six inch sections for asbestos-containing waste material. If no asbestos-containing waste material is observed visually in any core, the lower 6" core/sample will be analyzed for asbestos. In the event asbestos-containing waste material is observed in any of the cores, all 6" cores/samples (total of 4 samples) for that boring will be analyzed for bulk asbestos. Boreholes will be backfilled with sand from the borrow area.

Soil samples will be transferred from the split spoon to a stainless steel bowl, split lengthwise and placed in two 8 oz. glass jars. When analyzed, both halves will be treated as a single sample. The number of jars will be determined by the frequency of soil sampling events and the observance of asbestos in the soil. One duplicate sample will be collected for every 10 soil samples.

Soil cover boring will be conducted immediately after completion of the Remedial Construction Work and once again after five years. If no asbestos-containing plant waste material is encountered in the 12"-18" depth range of the sample core, the soil cover borings will be made every ten years after the two, initial boring events. If asbestos-containing material is encountered within 12" - 18" depth range, then the frequency of soil cover borings, thereafter, will be once every five years.

The total period of soil cover boring efforts will be a minimum of thirty years, similar to that of visual monitoring. After the period of thirty years, the need for further monitoring, if any, will be evaluated and approved by U.S. EPA and IEPA.

3.0 REMEDIAL CONTINGENCY PLAN

A contingency plan will be developed and submitted to U.S. EPA and IEPA for review and approval or conditional approval for evaluation of the upward migration of asbestos-containing material when it is encountered at levels above cover background levels at a 12" depth (6"-12" interval) in any core. The contingency plan developed will address remedial measures and a schedule for implementation.

U.S. EPA will evaluate the contingency plan and determine the need for implementation of remedial measures identified in the contingency plan based on the standards contained in Section 104A of CERCLA 42 USC Section 9604A.

4.0 SAMPLE ANALYSIS

Soil boring core samples will be analyzed for bulk asbestos using the NIOSH method 7400 (or currently accepted method).

5.0 PERSONAL PROTECTIVE EQUIPMENT AND DECONTAMINATION PROCEDURES

Level D personal protection will be utilized, including:

- Work clothes
- Outer gloves
- Particle/dust masks (Optional)
- Steel toe boots and hard hats (Optional)

All sampling equipment will be decontaminated between boreholes with a soap wash, tap water rinse and distilled water rinse to avoid cross-contamination by asbestos. Outer gloves will be cleaned between sample locations. Wash and rinse waters will be disposed of on-site.

6.0 SAMPLE DOCUMENTATION

A sample numbering system will be used for positive identification and to allow tracking, retrieval and cross referencing of sample information. Examples of sample numbers are shown below.

Example: MRA-SC01-02-D

where:	MRA	=	Manville Remedial Action
	SC01	=	soil cover location no. 1
	02	=	second depth range (6-12")
	D	=	duplicate

MRA-SC10-04

SC10	=	soil cover location no. 10
04	=	fourth depth range (18-24")

Measurements and observations will be documented in the field notebook. Additional information on sampling documentation can be found in Section 6.2 of the QAPP (C1).

7.0 SAMPLE PRESERVATION, PACKAGING AND SHIPPING

As outlined in Appendix C1-D, soil samples to be analyzed for asbestos will be placed in two 8 oz. wide-mouth glass jars with a Teflon-lined cap. No ice or preservatives are required. Packaging and shipping information is included in Section 6.1 of the QAPP (C1).

APPENDIX C1-B

ACTIVE WASTE DISPOSAL AREAS SAMPLING PLAN

ACTIVE WASTE DISPOSAL AREAS SAMPLING PLAN

1.0 INTRODUCTION

The miscellaneous disposal pit will be sampled to verify that no asbestos-containing waste materials have been deposited in this pit. The sludge disposal pit will be sampled to verify that no asbestos-containing sludge is near the surface. The influent to the process wastewater treatment system will be sampled and tested for total chromium, lead, total arsenic, antimony, aluminum, full scan of HSL volatiles, semi-volatiles, PCBs and PBBs. These sampling activities are designed to be carried out once for initial monitoring and after each significant process change, if any, in the future. A significant process change would be defined as one which is likely to alter the type and/or the level of hazardous pollutant(s) in the process waste water.

This sampling plan details the procedures to be followed for sampling the active waste disposal areas (miscellaneous disposal pit, sludge disposal pit and wastewater treatment influent); it documents sample collection, sample processing and sample documentation procedures.

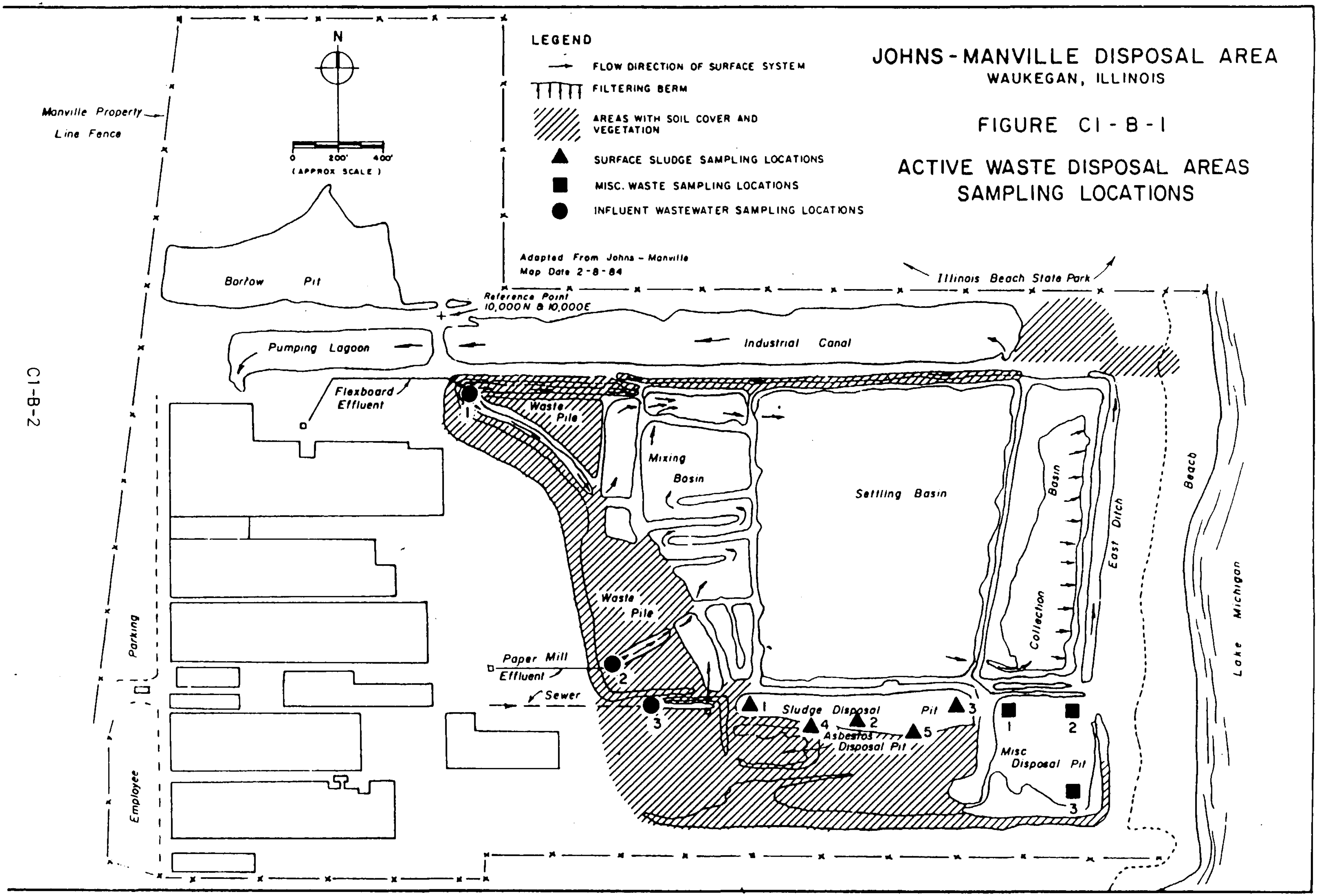
2.0 SAMPLE LOCATIONS

The miscellaneous disposal pit will be sampled at three locations and the sludge disposal pit will be sampled at five locations, as shown in Figure C1-B-1. Samples (for asbestos only) will be collected from three different areas around each of the sampling locations and composited to make one representative sample for that location. Sample Nos. 4 and 5 in the sludge disposal pit will be collected from the side slopes. Locations shown in Figure C1-B-1 are approximate and may be modified by U.S. EPA representatives on-site.

There are three potential process wastewater discharge lines (influent sewer line, paper mill effluent and flexboard effluent) and the flexboard effluent line is not in use at this time. Only the lines active at the time of sampling will be monitored at their entry to the respective treatment ditches at the locations shown in Figure C1-B-1.

3.0 EQUIPMENT

- Brass or steel shovels
- Isco samplers
- Clean glass jars, polyethylene and glass sample bottles, VOA vials
- Stainless steel spatula
- Brushes, buckets, pans, and bowls
- Plastic bags
- Soap (Alconox or equivalent)
- Water (distilled and tap)


JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS
FIGURE C1-B-1
ACTIVE WASTE DISPOSAL AREAS
SAMPLING LOCATIONS
LEGEND
FLOW DIRECTION OF SURFACE SYSTEM
FILTERING BERM
AREAS WITH SOIL COVER AND VEGETATION
SURFACE SLUDGE SAMPLING LOCATIONS
MISC. WASTE SAMPLING LOCATIONS
INFLUENT WASTEWATER SAMPLING LOCATIONS
Adapted From Johns-Manville
Map Date 2-8-84
N
0 200' 400'
(APPROX SCALE)
Manville Property Line Fence
Borrow Pit
Reference Point 10,000N & 10,000E
Illinois Beach State Park
Pumping Lagoon
Industrial Canal
Flexboard Effluent
Waste Pile
Mixing Basin
Settling Basin
Collection Basin
East Ditch
Beach
Lake Michigan
Parking
Employee
Paper Mill Effluent
Sewer
Sludge Disposal Pit
Asbestos Disposal Pit
Misc Disposal Pit
1
2
3
4
5

4.0 SAMPLING PROCEDURES

Sludge samples from the Sludge Disposal Pit and Miscellaneous Disposal Pit will be collected from the surface (0 to 12" depth) and near surface (12" to 24" depth) of both pits by using shovels. Waste/sludge samples from three different areas (within a 5 foot radius) around each sampling location will be thoroughly mixed in a stainless steel bowl and used to fill two glass jars from each of the eight sampling locations. Each sample will be split into two jars in case there is any breakage. All sample containers will be supplied by the analytical laboratories. No preservatives are necessary. A total of 18 samples (34 + jars) will be collected in 8 oz. glass jars, as summarized below:

Location	0-12"	12-24"		Total # of Jars	Number of Samples Analyzed
Sludge Disposal Pit					
1	2	2	=	4	2
2	3 (D)	2	=	5	3
3	2	2	=	4	2
4	2	2	=	4	2
5	2	2	=	4	2
Miscellaneous Disposal Pit					
1	2	2	=	4	2
2	2	2	=	4	2
3	3 (D)	2	=	5	3
				34	18

D = Duplicate sample

Wastewater influent samples from the active lines will be collected during weekdays and composited over a period of 24 hours using automatic samplers. An ISCO sampler or any other 24-hour sampling device will pump a representative aliquot of sample from each of the influent locations into a glass jar. No flow proportioning device is planned. Production of the manufactured products is more or less uniform 24 hours/day on weekdays; therefore, any sample collected over a period of 24 hours during weekdays will be a representative sample for a typical weekday production. The wastewater will be analyzed for chromium, lead, arsenic, antimony, aluminum, volatiles, semi-volatiles, PCB's and PBB's. Only volatile organics samples will be grab samples and not out of the 24-hour sampler. All other samples will be collected from each location over 24-hour periods, once for initial monitoring and again after each significant process change, if any, in the future. A maximum of 19 samples (if all the three lines are active) will be collected as follows:

Location	HDPE metals 1 l.	Glass Organic VOAs 40 ml.	Glass Extractables 1 l.	No. of Samples Analyzed
1	1	2	2	3
2 (Matrix spike and MSD)	1	6	6	7
3 (D,FB)	3	6	6	9
				19

A maximum of 19 samples will be analyzed during the initial sampling of wastewater influent. The number of samples will decrease to 16 if one waste line is permanently shut down; otherwise it will be sampled as soon as it is in use again. These samples will be preserved and stored as specified in Appendix C1-D. The appearance and condition of collected samples will be recorded in the field log book.

5.0 SAMPLE ANALYSIS

As summarized above, 18 samples from the disposal pit (including two duplicates) will be analyzed for asbestos.

In addition, 16 samples (if one wastewater line is permanently shut down) or 19 influent wastewater samples will be analyzed for total arsenic, total chromium, lead, antimony, aluminum, full scan of HSL volatiles, semi-volatiles, PCB's and PBB's. One duplicate and one field blank sample will be collected and analyzed for every 10 samples or less collected. Also, one matrix spike and one MSD will be collected for every 20 or less samples. Also, one trip blank (two 40-ml vials) will be shipped with each VOA shipping. Trip blanks will be prepared using HPLC grade distilled water in the office, transported to the field and shipped without being opened in the field. The number of VOA vials needed for trip blanks will be determined by the number of VOA shipping packages.

6.0 PERSONAL PROTECTIVE EQUIPMENT AND DECONTAMINATION PROCEDURES

Level D personal protection will be utilized, including:

- Disposable Tyvek coveralls,
- Outer gloves,
- Particle/dust masks,
- Steel-toed boots,
- and Hard hats,

unless the site safety officer determines that greater protection is needed.

All the sampling equipment will be decontaminated between samples to avoid cross-contamination between samples and sampling locations. Equipment will be decontaminated near each sampling location, and placed in plastic bags or wrapped in a plastic sheet for transportation to the next sampling location. The decontamination will consist of:

- Soap (alconox or equivalent) solution wash
- Potable water rinse
- Distilled water rinse

Personnel decontamination will be conducted as described in the Health and Safety Plan, Attachment G to the Work Plan. Outer gloves will be decontaminated between samples and sampling locations. Wash and rinse solutions can be disposed of on-site.

7.0 SAMPLE DOCUMENTATION

Documentation will provide a complete record of procedures followed in the field; will permit accurate identification of samples and tracking of their status in the field, during shipment and at the laboratory; and will facilitate chain of custody and accountability procedures by providing legible and concise information.

A sample numbering system will be used for positive identification and to allow tracking, retrieval and cross referencing of sample information. Examples of sample numbers are shown below:

Example: MRA-SDP02-01-D

Where:	MRA	=	Manville Remedial Action
	SDP02	=	Sludge Disposal Pit location no. 2
	01	=	first depth range (0-12")
	D	=	duplicate sample

MRA-MDP01-02

MDP01	=	Miscellaneous Disposal Pit location no. 1
02	=	second depth range (12-24")

MRA-WW01-01-FB

WW01	=	wastewater location no. 1
01	=	first 24 hr. round of sampling
FB	=	field blank collected at the location

Influent wastewater and sludge and waste disposal pit sampling activities will be documented through written entries in a field notebook as outlined in the QAPP. All field measurements and any other information specific to the sample will also be recorded.

Additional information on sampling documentation can be found in Section 6.2 of the QAPP (C-1).

8.0 SAMPLE PRESERVATION, PACKAGING AND SHIPPING

All samples will be preserved as presented in Appendix C1-D. Each sample container will be decontaminated and identified by a sample label. Labels on field blanks, duplicate samples or trip blank will be identified by "FB", "D" or "TB" suffix, respectively. The lid of each container will be taped shut to prevent any leakage. Each container will be stored and shipped in a cooler. Each cooler will be cushioned by vermiculite or other packaging material and at least two bags of ice will be placed in each cooler (except for coolers containing asbestos samples). Also, each cooler will contain the chain-of-custody form as detailed under Section 6.1 of QAPP C-1. The coolers will be either shipped or transported personally to the laboratory maintaining the chain-of-custody.

9.0 REMEDIAL CONTINGENCY PLANS

Remedial Contingency Plans are detailed in the following sections for Miscellaneous and Sludge Disposal pits and the Wastewater Treatment System.

9.1 Miscellaneous and Sludge Disposal Pits Remedial Contingency Plan

If any asbestos is detected in the Miscellaneous Disposal Pit or Sludge Disposal Pit, that pit will be provided with a soil cover consistent with the Consent Decree, and completed by May 31, 1990.

9.2 Wastewater Treatment System Remedial Contingency Plan

In the eveny any hazardous waste is identified to enter the process wastewater treatment system, a remedial contingency plan will be implemented. The Contingency Plan will include the identification of the compound against the list of materials received and manufactured by Manville. On the basis of this identification, discontinuance of the identified hazardous material or separate disposal of that hazardous waste stream will be evaluated.

A draft Work Plan, including a schedule for implementation of the above mentioned Contingency Plan, will be submitted to U.S. EPA and IEPA within 90 days of the sampling event for which analyses indicated hazardous waste entering the wastewater treatment system. A final Work Plan will be submitted within 30 days of Manville's receipt of U.S. EPA and IEPA comments on the draft work plan.

APPENDIX C1-C

GROUNDWATER AND SURFACE WATER MONITORING PROGRAM

GROUNDWATER AND SURFACE WATER MONITORING PROGRAM

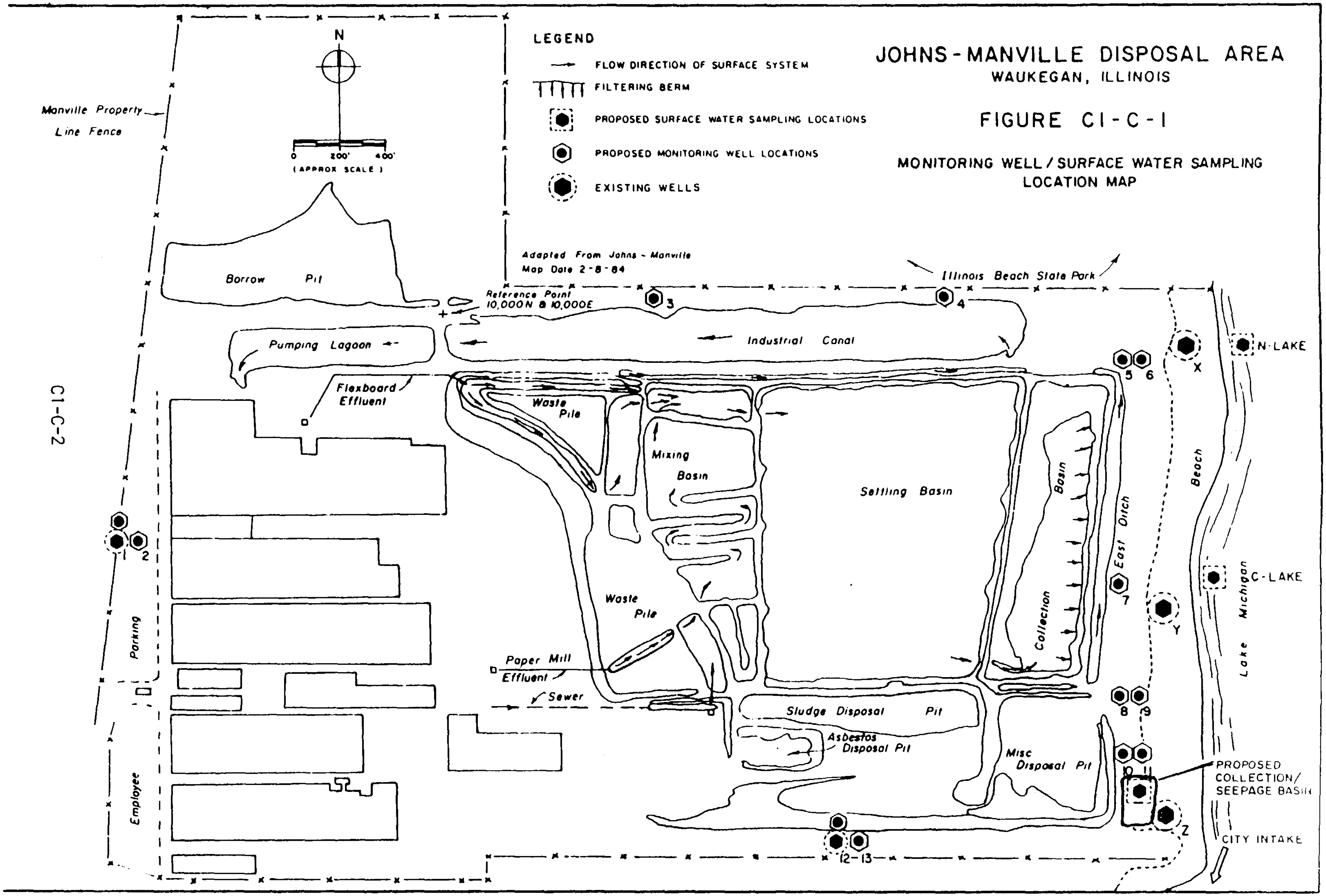
1.0 INTRODUCTION

Pursuant to the Consent Decree signed by Manville on December 31, 1987, Manville will sample groundwater and surface water on the site. The locations of proposed monitoring wells and surface water collection points are given in Figure C1-C-1. Construction details and drilling instructions for proposed monitoring wells are included in Attachment E of the Work Plan.

2.0 GENERAL GROUNDWATER AND SURFACE WATER SAMPLING CRITERIA

A monitoring plan which shall continue for a minimum of thirty (30) years, including 14 sampling events is presented. Following installation, the thirteen monitoring wells, two Lake Michigan shoreline surface water locations, one City of Waukegan Lake Water Intake Pipe outlet, and one site drainage collection/seepage basin location will be used to collect quarterly samples (every three months) for a period of two years (number of sampling events = 8). Parameters which will be analyzed include asbestos, lead, total chromium, total arsenic, aluminum, antimony, PCBs PBBs, and a full scan of semi-volatile and volatile organics. Following quarterly monitoring, samples will be collected once every five years (number of sampling events = 6) and analyzed for parameters indicated by previous data. After 30-years of monitoring, U.S. EPA and IEPA will evaluate the need for further monitoring and require appropriate action to be taken by Manville.

During the period of monitoring, if any measured groundwater quality parameter is statistically determined to exceed background/upgradient values (MW 1 and MW 2, Figure C1-C-1) or established drinking water standards (e.g. - MCLs), a groundwater Remedial Contingency Plan will be put into effect (Attachment F of Work Plan). For arsenic and asbestos, this contingency plan will be implemented if groundwater concentrations of arsenic exceed 50 ug/L or if asbestos concentrations are greater than 7.1 MFL (million fibers per liter) for those fibers longer than 10 um or whatever applicable groundwater standards for arsenic or asbestos are promulgated in the future. In the same regard, if any measured surface water quality parameter is statistically determined to exceed background levels (i.e., Illinois Water Quality Standards and/or numerical standards established in the Great Lakes Water Quality Agreement of 1978, or equivalent), a surface water Remedial Contingency Plan will be put into effect (Attachment F). For arsenic and asbestos, this contingency plan will be implemented if surface water concentrations of total arsenic exceed 50 ug/L (48 ug/L for pentavalent arsenic and 190 ug/L for trivalent arsenic) or if asbestos fiber concentrations are greater than 7.1 MFL for fibers longer than 10 um or whatever applicable surface water standards for arsenic or asbestos are promulgated in the future.



JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

FIGURE C1-C-1

MONITORING WELL / SURFACE WATER SAMPLING LOCATION MAP

3.0. SAMPLING OF GROUNDWATER

Static water levels referenced to the top of well casing will be measured to the nearest 0.01 foot and recorded for the purpose of monitoring the groundwater gradient at the site. Three established wells near the beach (labelled X, Y and Z), although not used for sampling, will be used for water level readings. Prior to sampling, water levels will be recorded using a level indicator, such as an electrical probe or woven tape with sinker. In the case of cluster wells, both water levels will be taken before any water is removed. The reference point (top of casing) elevation on the wells will be established by survey with respect to U.S. Datum, Mean Sea Level Elevation.

A minimum of three times the volume of standing water in the wells will be removed/purged prior to sampling. Purge water will be disposed of on site. If the well goes dry before three casing volumes have been taken out, samples will be collected as soon as the well recovers. Purging and sampling will be done by gently lowering a Teflon bailer attached to nylon rope or twine. During the sample withdrawal process, care will be taken to avoid physically altering or chemically contaminating the water. Observations of water clarity/turbidity, color and odor will be written in the field notebook. Also, temperature, pH and specific conductance will be measured and recorded in the field. The groundwater samples for dissolved metals will be filtered in the field using 0.45 micron filters. These samples will be preserved (acidified) after filtering. Sample containers will be provided by the laboratory. Standard VOA sample collection procedures, assuring elimination of headspace, will be used.

4.0 SAMPLING OF SURFACE WATER

Surface water samples will be grab samples from the Lake Michigan near-shore (N, C, and the City of Waukegan Lake Michigan water intake) and the site drainage collection/seepage basin location shown in Figure C1-C-1. Locations shown are approximate; U.S. EPA representatives may modify sampling locations in the field. Lake Michigan samples will be collected from an approximate 4 foot depth using a Niskin bottle/sampler. The City of Waukegan Lake Michigan water intake will be used for background water quality. Samples will be collected with the required volume of water using proper preservation techniques, as described in Appendix C1-D. No filtration of surface water samples for dissolved metals is needed. Preservative (acid) for dissolved metals is needed. Preservative will be added to the sample, as well as the field blanks, without filtering. Sample containers will be provided by the laboratory. During the sample collection process, care will be taken to avoid undue agitation, physically altering/chemically contaminating the samples. Observations on water clarity/turbidity, color and odor will be written in the field notebook. Also, temperature, pH and specific conductance will be noted in the field. Hip boots or waders can be worn, but for reasons of safety, a depth of four feet should not be exceeded.

5.0 FIELD BLANKS, DUPLICATES AND TRIP BLANKS

Field blanks and duplicates samples will be taken at two monitoring well locations and at one surface water location. Exact locations for these extra sample collections will be determined in the field during each sampling event, with preference given to those locations with a greater potential for contamination (e.g.-MW8, N-Lake). Duplicates (D) will be collected in the same manner as the respective sample. Field blanks (FB) will consist of deionized water. For the groundwater blank, the water will be poured into the decontaminated Teflon bailer at the monitoring well location, then transferred to the sample container. The field blank for dissolved metals will also be filtered and preserved. For the surface water blank, deionized water will be poured into the decontaminated Niskin bottle/sampler at a shoreline location, then transferred to the sample container. Preservative will be added.

For each shipping package (i.e. - cooler) which includes volatile organics (VOAs), two trip blanks (2 VOA vials) will be included. These blanks will contain HPLC-grade distilled water to detect any volatile organic contamination reaching a closed container. Trip blanks will be prepared in the office or laboratory, transported to the field and shipped without being opened in the field. "TB" will be used to identify all trip blank samples.

6.0 SAMPLE CONTAINERS

A summary of the sample containers used for each sampling event is presented; the number of glass containers is increased in case of breakage.

Monitoring Well Location	Polyethylene metals, 1 l	Polyethylene asbestos, 1 l	glass extractables, 1 l amber	glass VOAs, 40 ml	Number of samples analyzed
1	1	1	2	2	4
2	1	1	2	2	4
3	1	1	2	2	4
4	1	1	2	2	4
5	1	1	2	2	4
6	1	1	2	2	4
7	1	1	2	2	4
8	1	1	2	2	4
9	1	1	2	2	4
10	1	1	2	2	4
11	1	1	2	2	4
12	1	1	2	2	4
13	1	1	2	2	4
Duplicates, Field Blanks	4	4	8	8	16
Matrix Spike, and MSD	0	0	4	4	4
Surface Water Location					
N-Lake	1	1	2	2	4
C-Lake	1	1	2	2	4
City Intake	1	1	2	2	4
Seepage Basin	1	1	2	2	4
Duplicates, Field Blanks	2	2	4	4	8
Matrix Spike, and MSD	0	0	4	4	4

Totals = (46 polyethylene bottles) (54 glass bottles) (54 VOA vials)
= 154 bottles, total samples to be analyzed = 100

Samples will be preserved and stored as specified in Appendix C1-D. The number of VOA vials needed for trip blanks will be determined by the number of VOA shipping packages. Therefore, additional VOA vials and VOA analyses associated with trip blanks are not indicated in the table.

7.0 EQUIPMENT

- Clean polyethylene and glass sample bottles, VOA vials
- Teflon bailer, rope/twine
- Wading boots
- Plastic bags
- Soap (Alconox or equivalent)
- Water (tap and deionized)
- Brushes and buckets

8.0 SAMPLE ANALYSIS

As summarized in Section 6.0, a minimum of 100 samples from each event will be analyzed, which include samples for metals (aluminum, antimony, total arsenic, total chromium and lead), asbestos, extractables (full scan semi-volatiles, PBBs, PCBs) and volatile organics.

Analytical procedures used for each parameter are discussed in QAPP C1, Section 8.0.

9.0 PERSONAL PROTECTIVE EQUIPMENT AND DECONTAMINATION PROCEDURES

Because all sampling sites are located outside of the Manville disposal areas, level D personal protection will be utilized, including:

- Tyvek coveralls
- Outer gloves
- Particle/dust masks, if needed
- Safety boots/shoes
- Hard hats, if needed

Between each sample location (including individual wells in a well cluster), outer gloves and sampling equipment will be decontaminated using a soap wash (50/50 mix of trisodium phosphate and sodium carbonate), tap water rinse and distilled/deionized water rinse. For monitoring well samples, the nylon rope or twine will either have its saturated length removed or the entire line will be discarded in a garbage bag. Decontamination rinse and wash waters can be disposed of on site.

10.0 SAMPLE DOCUMENTATION

Documentation will provide a complete record of procedures followed in the field; will permit accurate identification of samples and tracking of their status in the field, during shipment and at the laboratory; and will facilitate chain of custody and accountability procedures by providing legible and concise information.

A sample numbering system will be used for positive identification and to allow tracking, retrieval and cross referencing of sample information. Examples of sample numbers are shown:

<u>MRA - SWN - 01 - D</u>

Where MRA = Manville Remedial Action
SWN = Surface water location "N-Lake" (northern)
01 = 1st round of sampling
D = Duplicate

<u>MRA - MW05 - 13 - FB</u>

Where MW05 = Monitoring Well no. 05
13 = 13th round of sampling
FB = field blank collected at the location

The date and time of collection will be recorded along with the sample number, on both the sample label and the field notebook. The sample parameter to be analyzed will also be written on all documentation.

All field measurements, as well as observations of water clarity/turbidity, color and odor, will be written in the field notebook. Additional information on sampling documentation can be found in Section 6.2 of the QAPP(C1).

11.0 SAMPLE PACKAGING AND SHIPPING

All samples will be preserved as presented in Appendix C1-D. Each sample container will be decontaminated and identified by a unique sample number. Labels on field blanks, duplicate samples or trip blanks will be identified by "FB", "D" or "TB" suffix, respectively. The lid of each container will be taped shut to prevent any leakage. Each container will be stored and shipped in a cooler. Each cooler will be cushioned by vermiculite or other packaging material and at least two bags of ice will be placed in each cooler (except for coolers containing asbestos samples). In addition, the cooler will contain the chain-of-custody form as detailed under Section 6.1 of QAPP C1. The coolers will be either shipped or transported personally to the laboratory maintaining the chain-of-custody.

APPENDIX C1-D

SAMPLE QUANTITIES, CONTAINERS AND PRESERVATIVES

SAMPLE CONTAINERS, VOLUMES AND PRESERVATION

Matrix	Test Parameters	Sample Bottles and Volume[1]	Preservation Requirements
Surface Water	Metals (Total)	1 1-Liter HDPE Bottle, Fill to Shoulder	5 ml 1:1 HNO_3
	Organic Volatiles	2 40-ML Glass VOA Vials, No Headspace[3]	Iced to 4°C
	Organic Extractables[2]	2 1-Liter Amber Glass Bottle; Fill to Neck[3]	Iced to 4°C
	Asbestos	1 1-Liter HDPE Bottle, Fill to Shoulder	None
Ground Water	Metals (Total)	1 1-Liter HDPE Bottle, Fill to Shoulder	5 ml 1:1 HNO_3
	Metals (Dissolved)	1 1-Liter HDPE Bottle; Fill to Shoulder	5 ml 1:1 HNO_3 Filtering, Iced
	Organic Volatiles	2 40-ML Glass VOA Vials; No Headspace[3]	Iced to 4°C
	Organic Extractables[2]	2 1-Liter Amber Glass Bottle, Fill to Neck[3]	Iced to 4°C
	Asbestos	1 1-Liter HDPE Bottle, Fill to Shoulder	None
Active Waste Water	Metals (Total)	1 1-Liter HDPE Bottle, Fill to Shoulder	5 ml 1:1 HNO_3
	Organic Volatiles	2 40-Ml Glass VOA Vials, No Headspace [3]	Iced to 4°C
	Organic Extractables[2]	2 1-Liter Amber Glass Bottles; Fill to Neck[3]	Iced to 4°C
Soils/ Sludge	Asbestos	2 8-ounce Glass Jars[3]	None

(1) Specific Sample bottles are shown as guidelines; sampling requiring similar bottle materials and preservation may be combined. The preferred number and size of bottles will be indicated by the laboratory.

(2) Organic Extractables include full-scan Semi-volatiles, Pesticides/PCB's, PBB's.

(3) Sample bottles will have teflon-lined caps.

APPENDIX C1-E

METHODOLOGY FOR PBB ANALYSIS

Methodology for PBB Analysis

1.0 Scope and Application

1.1 This method is applicable to the determination of trace amounts of polybrominated biphenyls (hexa bromo biphenyl) i.e., BP6 (PBB) in groundwater and surface water samples.

1.2 Method detection limits are listed in Table 2 of the Special Analytical Services Contract (SAS) No. 2902-E, of May 1987, between the U.S. EPA, Region V, Sample Management Office and Clayton Environmental Consultants. Due to the variety of interferences encountered, the method detection limits may not be obtainable on all samples. These detection limits will be adjusted to account for the interferences encountered, required dilutions, and any variation in sample size.

2.0 Summary of Method

2.1 Extraction, concentration and clean-up using solvents such as methylene chloride and n-hexane will be done in accordance with U.S. EPA's method 608, "Organochlorine Pesticides and PCBs", Federal Register, 49:209, Oct. 26, 1984.

2.2 The compounds will be analyzed by gas chromatography with capillary column and electron capture detector (GC/EC). When unknown samples are analyzed by this method, the identification of any single peak compound is supported by a second analysis utilizing a capillary column of different stationary phase polarity. In the case of a highly complex sample, confirmation of the analysis is done by gas chromatography/mass spectrometry (GC/MS) provided the sample is sufficiently concentrated. Recommended columns and operating conditions are listed elsewhere (see footnotes in Table 1 of the above-mentioned SAS, No. 2902-E) in this method.

3.0 Sample Collection, Handling and Preservation

3.1 The samples will be collected in 1-liter amber glass bottles and sealed with teflon-lined screw caps.

3.2 Samples will be stored in ice and will be refrigerated at 4°C in the lab until extraction.

4.0 Interferences

4.1 Interferences may be encountered due to a number of sources including: glassware, solvents, sorbents and the sample itself. Glassware and supplies will be routinely monitored through the use of reagent blanks to demonstrate the absence of interferences. The use of high quality supplies will reduce the occurrence of interferences.

4.1.1 Glassware (old and new) must be scrupulously clean. The glassware is to be cleaned as soon as possible after use. A rinse with the last solvent used will remove surface traces of the compounds of interest. The rinse is followed by scrubbing in hot soapy water. Stubborn stains may require Nochromix acid cleaning. The glassware is then rinsed with tap water followed by acetone. Prior to its next usage, the glassware will be pre-rinsed with petroleum ether. All solvents used for cleaning glassware will be discarded.

4.1.2 Interferences (i.e., aliphatic hydrocarbons) co-extracted with the sample are minimized through the use of gel permeation chromatography and silica gel chromatography. Some interferences may still exist after this cleanup. These interferences may be accounted for through the analysis with an alternate column and/or GC/MS confirmation and the initial results may be adjusted for the interference.

4.1.3 Sulfide poisons electron capture detectors. Sulfides may be removed by adding one to three drops of mercury to the fraction prior to analysis.

NOTE: Mercury is toxic to humans; therefore, handle with care and dispose of properly.

5.0 Apparatus

Apparatus required for extraction, concentration and cleanup will be the same as described in U.S. EPA Method 608.

Analytical (qualitation/quantitation) equipment needed are described below.

5.1 Gas chromatograph - Varian 3700 (or equivalent) system capable of temperature programming and with split/splitless/direct capillary injector capabilities. This also includes necessary accessories such as auto sampler (Varian 8000 or equivalent), vials, caps, septa, electron capture detector, recorder, etc.

5.2 Capillary Columns - Capillary Columns will be the same as described in item 10, page 2 of the SAS, No. 2902-E.

5.3 Gas chromatograph/mass spectrometer (GC/MS) - Hewlett Packard Model 5985E complete with a model 5840 temperature programmable gas chromatograph suitable for split/splitless capillary injection. Mass spectrometer capable of scanning from 45 to 400 amu every second utilizing 70 eV (nominal) electron energy in the electron impact ionization mode. The Fused Silica Capillary Column (FSCC) is interfaced directly into the ion source. Continuous acquisition and storage of mass spectra is obtained throughout the duration of the gas chromatographic program by a Hewlett Package model 1000-E Series computer.

6.0 Extraction, Concentration, Cleanup

Extraction, concentration and cleanup, etc. for the PCBs/PBBs will be in accordance with the U.S. EPA's CLP protocols for pesticides/PCBs as per SOW-7-87-Organics and as described in EPA Method 608 CLP-M, "Organochlorine Pesticides and PCBs", Federal Register, 49:209, Oct. 26, 1984.

7.0 Analysis by Gas Chromatography

7.1 Sample analysis will be carried out using GC/EC.

7.2 Page 2 of item 10 of the SAS, No. 2902-E, summarizes the recommended capillary columns and operating conditions for the instrument. Included in the table are estimated retention times that should be obtained.

7.3 Two microliters will be injected from each standard and sample via autosampler.

7.4 If the response of any identified compound is greater than that of the compound found in the standard, a dilution is to be performed and the sample will be reanalyzed.

7.5 Single peak compounds are to be analyzed on a capillary column of differing polarity for confirmation. If the sample is highly complex, confirmation will be performed by GC/MS if the levels are sufficiently high.

7.6 Confirmation of Positive Results by GC/MS.

7.6.1 Performance criteria for the MS is given in Tables 10 and 11 of the SAS, No. 2902-E.

7.6.2 Once a week the system is calibrated according to manufacturer's specifications using Perfluorotributylamine (PFTBA). The resulting mass spectrum must meet the criteria established in Table 11 of the SAS, No. 2902-E.

7.6.3 Daily check the GC/MS performance by injecting a 50 ng/ul of Decafluoro Triphenyl Phospine (DFTPP) and verifying that the resulting mass spectrum meets the criteria of Table 10 of the SAS, No. 2902-E.

7.6.4 Stable isotope Anthracene d_{10} will be used as the reference spike. About 20 ng of the standard will be added to each sample just before injecting onto the GC column.

7.6.5 Inject 1.0 ul of sample onto the GC column using a 10.0 ul calibrated needle syringe. Record the volume injected to the nearest 0.1 ul.

7.6.6 If the response of any ion exceeds the working range of the GC/MS system, dilute the extract and reanalyze.

7.6.7 To qualitatively identify a compound, an extracted ion current profile for the characteristic ions is obtained.

7.6.8 The characteristic ion for the compound must be found to maximize in the same or within $\pm$ 0.05 of the relative retention time (RRT). If coelution of interfering components prohibits accurate assignment of the sample component from the total ion chromatograph, the RRT should be assigned by using extracted ion current profiles for ions characteristic of the compound of interest.

7.6.9 The relative intensities of ions must agree within $\pm$20% between the standard and sample spectra.

7.6.10 Structural isomers that have very similar mass spectra can be explicitly identified only if the resolution between isomers is less than 25% of the sum of the two peaks. Otherwise, structural isomers will be identified as isomeric pairs.

8.0 Quality Control

8.1 Sample Control

8.1.1 The sample batch will consist of 19 samples, one reagent blank, one matrix blank and two matrix spikes.

8.1.2 Cleanup control is intiated at the GPC step and consists of two GPC blanks and one working standard.

8.1.3 All samples will be spiked with known concentrations of 2,4-Dichlorotuluene and Decachlorobiphenyl prior to extraction. The percent recovery of these compounds indicates possible problems which may occur during extraction and clean-up of individual samples.

8.1.4 The GC analysis sequence includes standards, blanks, spikes and samples of which only standards are considered as known. There are a maximum of ten injections of unknown samples between standards. If evidence exists that maxtrix is causing shifts in sensitivity or retention times, the frequency of standard injections will be increased.

8.2 GC Controls

8.2.1 All injections will be performed using an autosampler. The injector is modified to perform all injections using the splitless technique utilizing a 0.7 min valve closure upon injection of 2.0 microleters.

8.2.2 The system is calibrated by using a standard containing compounds of approximately 75% of their linear range. The linearily is checked by injecting a low standard at or near 25% of the linear range of each compound. Means and 95% confidence limits are established for each compound. The performance was originally established based on ten consecutive runs. A minimum of seven injections are required to adjust calibration. Values for calibration standards must fall within the 99% confidence limits before the analysis may be performed. Outliers indicate possible performance problems which require appropriate action.

8.2.3 A known concentration of a,a,2,6-tetrachlorotoluene and trichloropropane will be added to every sample prior to GC analysis. These compounds are used to monitor retention time shifts, injection problems, and detector response.

8.2.4 Reference samples containing known concentrations of analytes will be obtained from U.S. EPA and extracted, cleaned, and analyzed four times per year.

9.0 Calculations

9.1 All compounds identified will be quantified by external standard method. The equation for this calculation is:

$$\text{Concentration (ug/kg)} = \frac{P_x\, C_s\, D\, V_s}{P_s\, V_x\, W_o}$$

Where: P_x = area of the compound in the sample
P_s = area of the compound in the standard
C_s = concentration of the compound in the standard
D = dilution factor for the sample
V_s = volume of standard injected
V_x = volume of sample injected
W = mass of the original sample in kg

9.2 Multiple peaks will be similarly calculated

9.2.1 The analyst must be experienced in recognizing the peak pattern of the compounds prior to calculations.

9.2.2 Select five to ten major peaks from the standard and calibrate each peak for quantification. If no interferences are apparent, the average concentration is obtained from the identified and calibrated peaks with the same retention time as the standard.

9.2.3 Calibrated peaks which indicate the presence of interference are not included in the calculation.

All results are to be reported in ug/kg. The results may not be corrected for percent recovery, but results will be coded if the percent recovery falls outside the method validation recovery range.

10.0 Method Validation

10.1 Method Detection Limit - The method detection limit (MDL) for each compound will be determined from low level spikes of tap water using the MDL procedure from Appendix B, Part 136: "Definition and Procedure for the Determination of the Detection Limit", Federal Register, 49:209, Oct. 26, 1984.

10.2 Precision - The precision will be determined by standards and duplicate matrix spikes. The standards indicate the precision generated by the analysis and the duplicate matrix spikes define the precision of the extraction, cleanup and analysis.

10.3 Accuracy - Accuracy will be assessed in determining the recovery of the duplicate matrix spikes.

11.0 Reported Detection Limits

11.1 The MDL is the optimal performance of the method. This is not always obtainable due to variations in sample matrix and variability in extraction and cleanup which may adversely affect performance. For these reasons, the laboratory routinely uses reported detection limits (RDLs) which are generally higher than the MDLs.

11.2 RDL's for specific comounds may be raised because of interferences encountered during analysis.

11.3 If the original sample weight differs from 20 grams, the RDL for all compounds will be adjusted proportionally.

ATTACHMENT C-2

QUALITY ASSURANCE PROJECT PLAN - 2

AMBIENT AIR MONITORING

OF

PM_{10}, LEAD AND TOTAL CHROMIUM

QUALITY ASSURANCE PROJECT PLAN - 2

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C2-A: Ambient Air Sampling Plan for PM_{10}, Lead and Total Chromium

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QUALITY ASSURANCE PROJECT PLAN - 2

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP-2) presents the organization, objectives, functional activities, quality assurance (QA) and Quality Control (QA) activities associated with air sampling for lead, total chromium and particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}). Its format is the same as QAPP 1 (Attachment C1), with attempts to avoid repetition. Air sampling is a part of the Remedial Action being implemented at Johns-Manville Disposal Area.

2.0 PROJECT DESCRIPTION

2.1 Background

The Johns-Manville Disposal Area is located in the city of Waukegan, Illinois. Since 1922, all the manufacturing wastes from the plant have been disposed of at the Disposal Area. Some of these wastes contained encapsulated asbestos, friable asbestos, and trace amounts of lead, chromium, and other contaminants. Presently, no asbestos is being used in manufacturing.

In 1982, this site was included in the National Priorities List. A Remedial Investigation (RI) and Feasibility Study (FS) were conducted by Manville Corporation. Pursuant to the Consent Decree signed by Manville on December 31, 1987, Manville Corporation will carry out a Remedial Action.

2.2 Objective and Use of Data

The objective of sampling activities described in this QAPP is to detect potential ambient air contamination by PM_{10}, lead or chromium after the establishent of soil cover. For PM_{10} sampling, EPA-approved PM_{10} samplers or modified hi-volume samplers, will be utilized and hi-volume samplers will be used for lead and chromium sampling. Data obtained will be used to determine the need for any contingency measures needed to control and minimize detected or potential contamination.

2.3 Sampling Schedule

The schedule for sampling activities, is presented in Figure 2 of the Work Plan. Air sampling will be conducted after thhe establishment of soil and vegetative cover and every five years thereafter for a period of 15 years (number of sampling events = 4). After the 15 years, U.S. EPA will evaluate the need for further monitoring.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

3.1 Organization

The project organization is presented in Figure C2-1.

3.2 Responsibilities

Overall project supervision and coordination will be the responsibility of Johns-Manville Project Coordinator. He will be responsible for accomplishing the tasks as per the directives of "Consent Decree", as well as interacting with and reporting to U.S. EPA and Illinois EPA (IEPA).

All project functional responsibilities lie with the Manville Remedial Construction Manager (RCM). He will be responsible for overseeing certain project tasks and ensuring their accomplishment. He will be responsible for reporting the project progress to the Johns-Manville Project Coordinator and interacting with U.S. EPA and IEPA on an as-needed basis.

Overall coordination of on-site sampling/monitoring activities will be the primary responsibility of the Contractor/Consultant Site Manager (CSM). The independent Quality Assurance Monitor will be responsible for reviewing project documents and reports with respect to their conformance to the quality assurance objectives.

A contractor/laboratory will be identified for field sampling and measurement and data assessment. Laboratories identified earlier in QAPP-I will be used for sample analysis. U.S. EPA/IEPA representatives will be notified in advance of all monitoring/sampling activities.

4.0 QUALITY ASSURANCE OBJECTIVES

The overall QA objective is to develop and implement procedures for sampling, laboratory analyses, field measurements and reporting that will provide data to a degree of quality consistent with its intended use.

4.1 Level of QC Effort

Field blanks, lab blanks, lab duplicates and spike duplicates will be taken and analyzed to provide a means to assess the quality of the data resulting from the field sampling and lab analysis program. Field blank samples will be analyzed to check for procedural contamination of the samples.

The general level of this QC effort will be a collection of field blanks and an analysis of one lab duplicate (for lead and chromium only), and one lab blank for every ten or less investigative samples collected on-site. One lab matrix spike and one laboratory matrix spike duplicate will be analyzed for every twenty or less investigative samples collected.

Project Organization

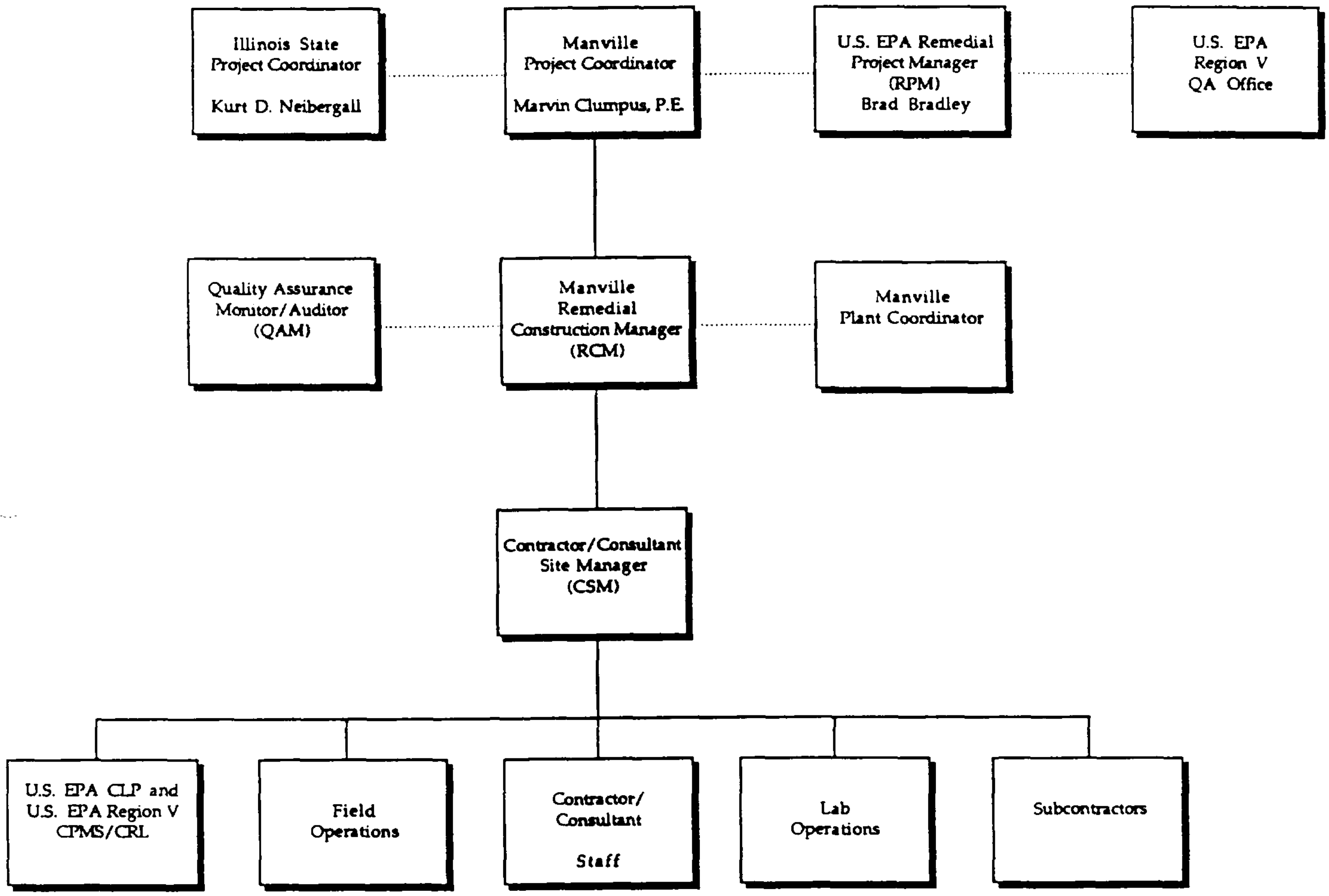


Figure C2-1

Field blanks for on-site and off-site sampling will be one for each type of samples per day. Hence, three blanks for on-site and three blanks for off-site group of locations will be collected. Two field blanks for on-site and one blank for off-site locations will be analyzed for lead and total chromium. Two field blanks for on-site and one field blank for off-site locations will be analyzed for PM_{10}. The number of samples to be collected and analyzed are presented in Table C2-A-1 of Appendix C2-A. The QC level of effort for testing is presented in Table C2-1.

The field instruments will be calibrated as prescribed under U.S. EPA regulations presented in Appendix C2-B. In general, the flow measuring device will be calibrated once, before the start of sampling event.

4.2 Accuracy and Precision

Accuracy and precision requirements of all parameters will be in accordance with standard requirements for sampling procedures published by U.S. EPA and presented in Appendix C2-B. The detection limits for lead and chromium testing will be 0.02 mg per filter and the accuracy of lead and chromium measurement from the filter will be ±10%. Table C2-2 presents the accuracy and precision criteria for lead and chromium by AAS.

4.3 Completeness, Representativeness and Comparability

The procedures used to obtain the analytical data, as documented in this QAPP, are expected to be complete, representative and will provide comparable data. It is expected that the lab chosen for analysis will provide data meeting QA criteria for 95 percent or more of all samples tested.

4.4 Facilities and Equipment

The field sampling equipment will be identified in the sampling plan (Appendix C2-A). A laboratory having facilities similar to those listed under U.S. EPA Contract Laboratory Program (CLP) will be selected for analysis of air samples. The laboratory selected will be subject to performance and system audits for approval/disapproval by the Contract Project Management Section (CPMS) of the U.S. EPA Revion V, Central Regional Laboratory (CRL).

5.0 SAMPLING PROCEDURE

The objectives of sampling procedures is to obtain samples that represent the environmental matrix being investigated. Procedures to collect the samples during the project are described in the sampling plan (attached as Appendix C2-A), and sampling and analysis procedures described in 40 CFR 50.12 (attached as Appendix C2-B).

Table C2-1
QC Level of Effort For Analytical Testing

Parameters	Audit	Frequency
Metals	Calibration Blank (AA or AA-Furnace)	Each calibration beginning and end of each run, 10% frequency
	Initial Calibration Verification (AA or AA-Furnace)	Daily and each instrument setup
	Continuing Calibration Verification (AA or AA-Furnace)	Beginning and end of each run; 10% frequency or every 2 hrs, whichever is more frequent
	Preparation Blank (AA or AA-Furnace)	One per batch or one per 20 samples received, whichever is more frequent
	Analytical Matrix Spike Analysis (AA)	One per case or one per 20 samples received, whichever is more frequent
	Duplicate Sample Analysis (AA or AA-Furnace)	One per case or one per 20 samples received, whichever is more frequent
	Laboratory QC Sample Analysis (AA or AA-Furnace)	One per batch or one per 20 samples received, whichever is more frequent
	Duplicate Injections (AA-Furnace)	Each sample
	Preparation Blank Spike Recovery (AA-Furnace)	One per batch or one per 20 samples received, whichever is more frequent
	Analytical Matrix Spike Analysis (AA-Furnace)	Each sample

Table C2-2
Accuracy and Precision Criteria for Analytical
Testing of Lead and Total Chromium

Method	Audit	Control Units
AA Flame or Furnace	Calibration Blank	≤D.L.
	Initial Calibration Verification	90-110%
	Continuing Calibration Verification	90-110%
	Preparation Blank	≤D.L.
	Matrix Spike Analysis	75-125%
	Laboratory QC Sample Analysis	80-120%
	Preparation Blank Spike Recovery	75-125%

6.0 SAMPLE CUSTODY

6.1 Sample Handling, Shipping and Custody

U.S. EPA-recommended sample handling, shipping and custody procedures will be followed. After sampling, the filter will be removed from the sampler, and placed in the filter holder as prescribed by the manufacturer and U.S. EPA, and presented in Appendix C2-B.

Each sample (filter) will be issued a unique project identification number.

The protective filter holders will be either hand-carried or shipped to the laboratory in a manner such as to prevent dislodging of particulate matter or breakage of the filter holders.

6.2 Field Documentation

A field logbook will be maintained and the following information will be recorded:

- Name and signature of field operator;
- Lot or assigned batch number (or any other identifiable number);
- Date of record;
- Station location and name;
- Use of filter, (i.e., field blank or test filter);
- Condition of sample;
- Sample flow rate at start of sampling period;
- Start time;
- Stop time;
- Sample flow rate at end of sampling period;
- Any specific instructions/comments.

A traceability packing slip will be filled out in the field. The samples will be either hand carried or shipped to the laboratory for chemical analyses, where the package contents will be compared to the traceability packing slip (chain of custody). After the samples are logged in, they will be placed in suitable storage areas in the lab.

6.3 Project File

A project file will be maintained by Manville Remedial Construction Manager which will contain complete project documentation including project plans, specifications, field sampling documents, and the analytical data provided by the lab.

7.0 EQUIPMENT CALIBRATION

All field equipment utilized during this project will be calibrated and operated according to the standard operating procedures as presented in Appendix C2-B. Calibration of instruments used for the analysis of lead and total chromium will conform to the procedures in SOW-7-87-Inorganics.

8.0 ANALYTICAL PROCEDURES

All samples collected will be analyzed for the appropriate parameter using U.S. EPA approved procedures, as presented in the Sampling Plan. Lead and chromium will be analyzed by atomic adsorption after acid extration using HNO_3. PM_{10} will be analyzed by weighing the filter on a scientific balance.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

The analytical laboratory will review appropriate laboratory quality control data to assure the validity of the analytical results provided to the contractor. Full analytical and QC documentation will be prepared and retained by the laboratory. All raw data generated from analyses of samples, blanks, duplicates and matrix spikes will be checked for compliance with QA objectives and reported to the RCM/CSM. Where test data have been reduced, the method of reduction will be described in the lab report.

10.0 INTERNAL QC CHECKS

Testing for metals will be performed using methods similar to the analytical procedures specified in CLP SOW 7-87-Inorganics. The internal QC procedures associated with testing of these parameters have been described in Section 4.0.

11.0 PERFORMANCE AND SYSTEM AUDITS

System audits are performed on a semi-continuous basis as appropriate throughout the duration of the project. The Contractor/Consultant Site Manager (CSM) is responsible for supervising and checking that samples are collected and handled in accordance with the approved project plans and that documentation of field work is adequate and complete. The RCM/CMS is responsible for overseeing that the project performance satisfies the QA objectives, as set out in this QAPP.

Performance audits of laboratories participating in the CLP or approved for CLP-type testing are performed in accordance with the procedures and frequencies established for the CLP by EPA.

The Quality Assurance Auditor is responsible for monitoring and auditing the performance of the QA procedures listed in this plan. He will maintain continuous communication with the RCM/CSM. Also, external audits will be performed by the Contract Project Management Section (CPMS) of Region V, Central Regional Laboratory (CRL).

The Quality Assurance Monitor is responsible for the review of work quality and will ensure that quality assurance procedures are being implemented.

12.0 PREVENTIVE MAINTENANCE

Preventive maintenance on all field equipment will be carried out in accordance with their standard operating procedures and as described in in Appendix C2-B. A routine preventative maintenance program may be conducted by the laboratory for laboratory equipment.

13.0 DATA ASSESSMENT PROCEDURES

The Quality Assurance Monitor/Auditor will review the analytical results for compliance with established QC criteria. Any problems arising during sample collection, packing, shipping or analysis will be taken into consideration during the data assessment.

14.0 CORRECTIVE ACTION

Any non-conformance to the previously established criteria or protocol in equipment, instruments, data, methods, etc. would be immediately reported to the supervisor and/or task leader. Necessary corrective action will be initiated by the Quality Assurance Monitor and implemented by the Remedial Site Project Coordinator (RSPC).

15.0 QUALITY ASSURANCE REPORTS

The complete and correct implementation of this QAPP will be reviewed by the RCM/CSM. Any deviations from this QAPP or any concern arising during the project requiring significant changes in the QAPP also will be identified by the RCM/CSM. The RCM/CSM will propose adjustments required to Manville Corporation, Project Coordinator and U.S. EPA, and after approval by U.S. EPA, will ensure their implementation. The QA-related information will be included in the monthly progress reports to U.S. EPA and IEPA, as applicable. No separate QA reports will be submitted.

16.0 SAMPLING PLAN

The Ambient Air Sampling Plan for PM_{10}, lead and chromium is presented as Appendix C2-A of this QAPP.

APPENDIX C2-A

AMBIENT AIR SAMPLING PLAN

FOR

PM_{10}, LEAD AND TOTAL CHROMIUM

AMBIENT AIR SAMPLING PLAN
FOR
PM_{10}, LEAD AND TOTAL CHROMIUM

1.0 INTRODUCTION

This sampling plan presents the procedures to be followed during ambient air sampling for particulate matter, lead and total chromium to be carried out at the Johns-Manville Disposal Area. Initial sampling is scheduled to be conducted after the completion of Remedial Work and establishment of vegetative cover on the site, and every five years thereafter for a minimum period of 15 years (number of sampling events = 4), as shown in Figure 2 of the Work Plan. After 15 years, U.S. EPA will evaluate the need for further monitoring. Establishment of vegetation will be considered adequate after three mowings of planted grass. Ambient air will be sampled for particulate matter, lead and total chromium using on-site and off-site locations. Sample collection, processing, analyses and documentation procedures are presented in this sampling plan.

2.0 SAMPLE LOCATIONS

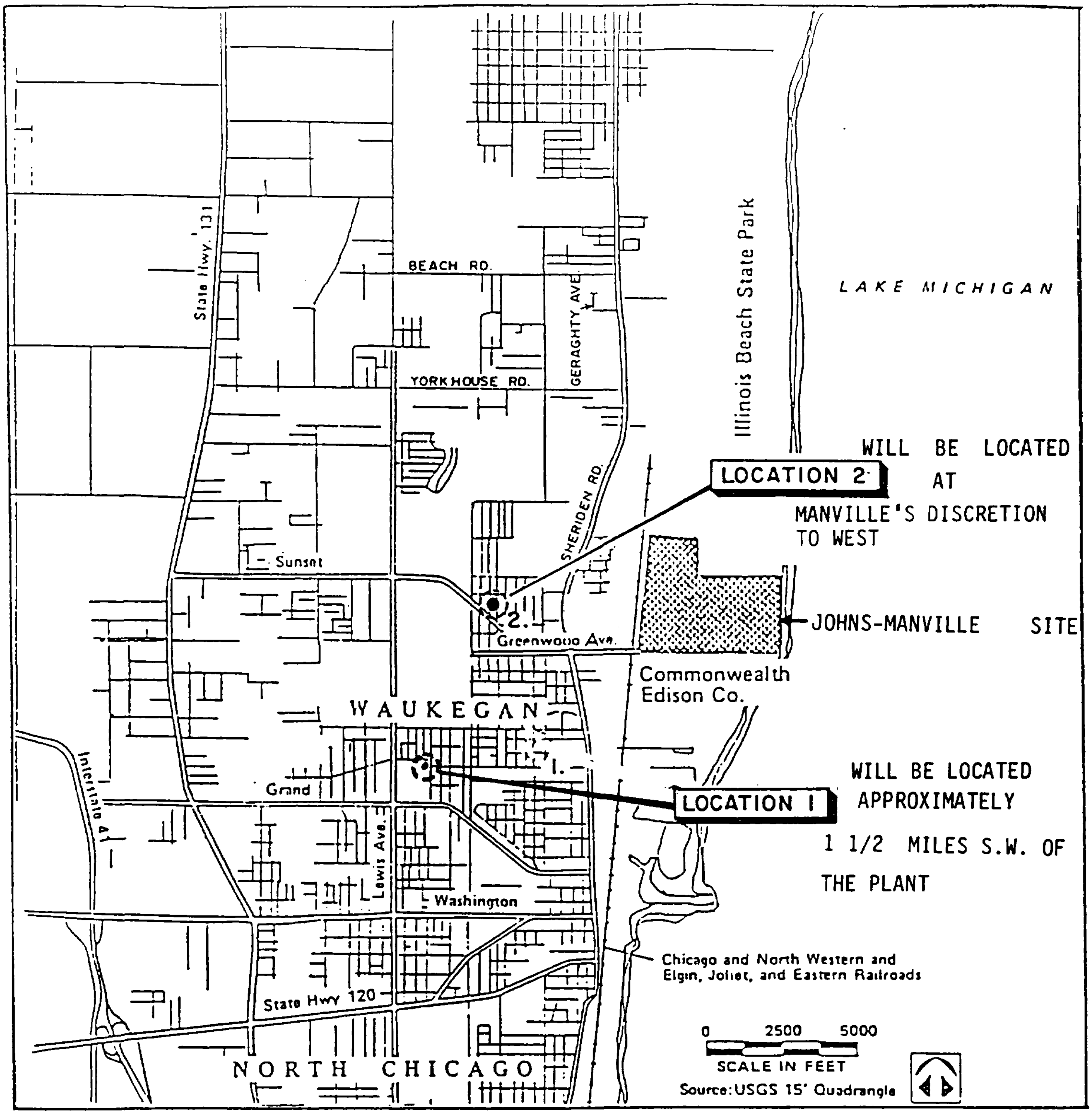
Air sampling locations should be such that air samples collected are representative of air quality on and around the Disposal Area. To accomplish this, two off-site and five on-site sampling locations have been selected, as shown in Figures C2-A-1 and C2-A-2. These locations are the same as proposed for air sampling for asbestos.

3.0 EQUIPMENT

- PM_{10} samplers
- High volume samplers
- Glass fiber filters
- Portable power generators
- Sampler shelter
- Air flow measurement device (rotameter)
- Thermometer
- Barometer
- Wind vane and Anemometer

4.0 SAMPLING PROCEDURE

Lead (Pb) and total chromium (Cr) samples will be collected on an 8" x 10" IPM 2000 spectograde filter using a high volume (Hi-Vol) sampler. The air volume will be between 39 cfm and 60 cfm. The Hi-Vol samplers will be calibrated and operated in accordance with the procedures outlined in Appendix C2-B of QAPP 2. Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}) will be collected using a PM_{10} sampler or modified hi-volume

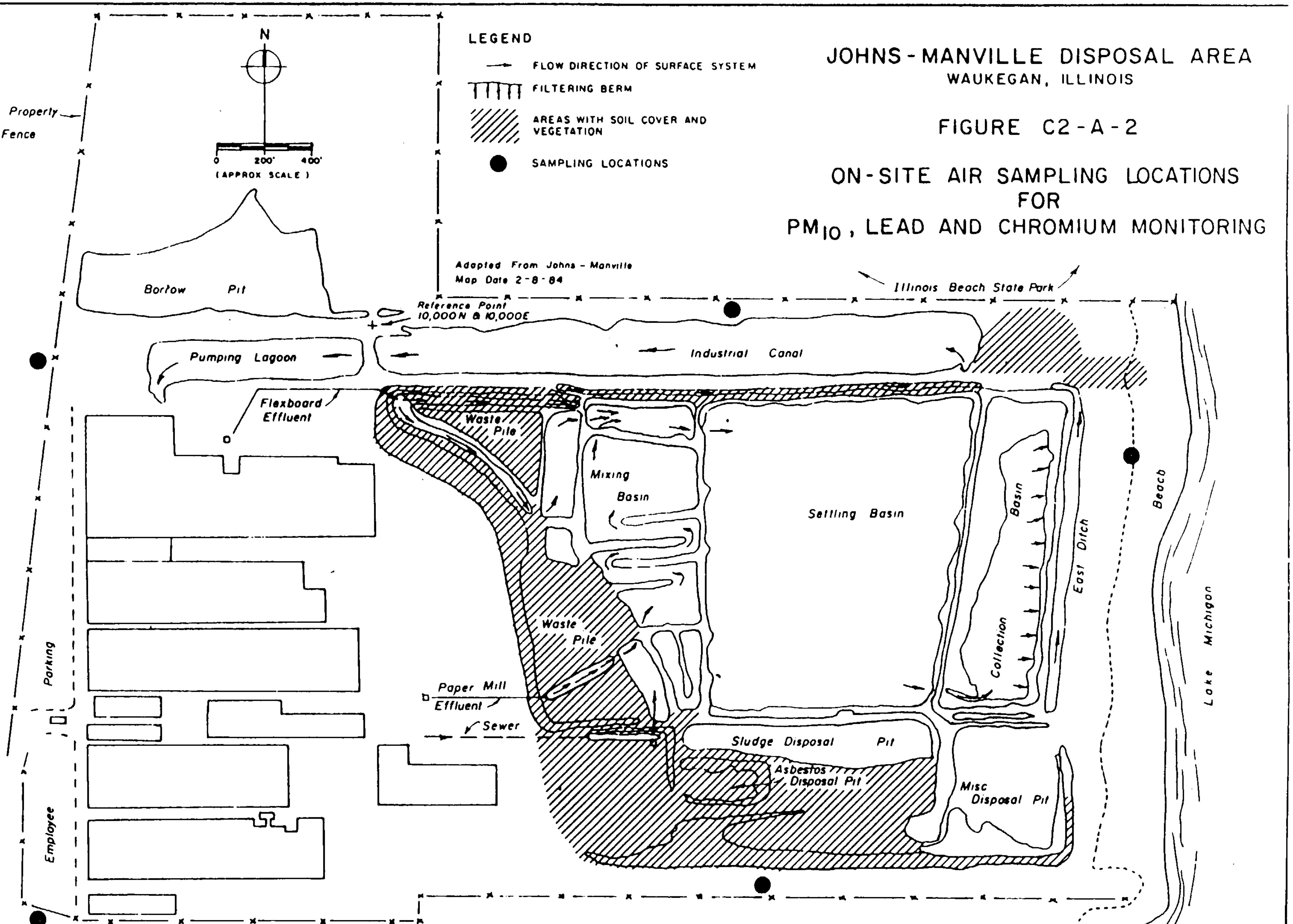


LEGEND

OFF-SITE LOCATIONS

JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

FIGURE C2-A-1



JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

FIGURE C2-A-2

ON-SITE AIR SAMPLING LOCATIONS FOR PM_{10}, LEAD AND CHROMIUM MONITORING sampler approved by U.S.EPA as a reference or equivalent method. This PM_{10} sampler will be calibrated and operated in accordance with manufacturer's instructions and the procedures outlined in Appendix C2-B. All the samples will be collected over a period of 24±1.0 hours, on three (3) separate days at each of the seven (7) locations. The field blanks will be collected for lead and chromium as well as PM_{10} analyses. A filter will be removed from the box of clean filters (touching only the outer edges of filter) and placed in the labelled filter holder in the field. The number of samples and analyses are presented in Table C2-A-1. Air temperature, pressure, wind direction and velocity at each sampling location will be recorded twice daily. Sampling will be conducted during the dry season and will not immediately follow a rainfall event, as approved by the U.S. EPA technical staff.

5.0 SAMPLE ANALYSIS AND HANDLING

PM_{10} and lead sample analysis will be carried out as presented in Appendix C2-B. Total Chromium will be extracted from the filter with nitric acid and the extract will be analyzed by Atomic Absorption Spectrophotometry (AAS). Filters will be handled in a manner consistent with those described in Appendix C2-B to maintain sample integrity.

6.0 PERSONAL PROTECTIVE EQUIPMENT

During collection of air samples, level D personnel protection, including outer gloves and work boots will be used.

7.0 DOCUMENTATION

Proper documentation of sample custody procedures, followed in the field and in the laboratory, will be maintained for accurate identification and tracking of each sample filter. A sample number to designate each sample location and frequency will be used to positively identify each sample collected.

8.0 SAMPLE PRESERVATION, PACKAGING AND SHIPPING

After sampling, the filters will be carefully removed from the sampler following manufacturer's instructions. Only outer edges of the filter will be touched. The filter will be placed in a filter holder as prescribed by U.S. EPA and presented in Appendix C2-B. The protective filter holders, containing filters, will be either hand carried or shipped in a manner such as to prevent dislodging of collected particulate matter or breakage of the filter holders. A chain-of-custody form will be included in the shipping package.

Table C2-A-1

Number of Samples and Analyses

	Field Blanks				Test Samples (filters)				Lab Blank		Duplicates	
	Offsite		On Site		Off Site		On Site				Spike	Sample
	PM_{10}	PB/Cr	PM_{10}	Pb/Cr	PM_{10}	Pb/Cr	PM_{10}	Pb/Cr	PM_{10}	Pb/Cr	PM_{10}	Pb/Cr
Filters to be collected in the field	3	3	3	3	6	6	15	15	-	-	-	-
Filters to be collected in the lab	-	-	-	-	-	-	-	-	2	2	-	-
Filters to be analyzed	1	1	2	2	6	6	15	15	1	1	4*	2

*Two on-site filters to be spiked for lead
Two on-site filters to be spiked for chromium

<u>APPENDIX C2-B</u>

U.S. EPA RECOMMENDED SAMPLING AND ANALYSIS PROCEDURE

FOR

- **LEAD/TOTAL CHROMIUM (C2-B, p. 1-16)**
- **PM_{10} (C2-B, p. 17-22)**

ENVIRONMENTAL PROTECTION AGENCY REGULATIONS ON NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

(40 CFR 50; 36 FR 22384, November 25, 1971; as amended by Code of Federal Regulations, Volume 40, revised as of July 1, 1976; 41 FR 52686, December 1, 1976; 43 FR 46258, October 5, 1978; 44 FR 8220, February 8, 1979; 44 FR 37915, June 29, 1979; 46 FR 44163, September 3, 1981; 47 FR 54899, December 6, 1982; 48 FR 628, January 5, 1983; 48 FR 2529, January 20, 1983; Corrected by 48 FR 17355, April 22, 1983)

SUBCHAPTER C—AIR PROGRAMS

PART 50—NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

Authority: Sec. 109, Clean Air Act, as amended 42 U.S.C. 7409.

[Amended by 48 FR 628, January 5, 1983]

§ 50.1 Definitions.

(a) As used in this part, all terms not defined herein shall have the meaning given them by the Act.

(b) "Act" means the Clean Air Act, as amended (42 U.S.C. 1857–1857l, as amended by Pub. L. 91–604).

(c) "Agency" means the Environmental Protection Agency.

(d) "Administrator" means the Administrator of the Environmental Protection Agency.

(e) "Ambient air" means that portion of the atmosphere, external to buildings, to which the general public has access.

(f) "Reference method" means a method of sampling and analyzing the ambient air for an air pollutant that is specified as a reference method in an appendix to this part, or a method that has been designated as a reference method in accordance with Part 53 of this chapter; it does not include a method for which a reference method designation has been cancelled in accordance with §53.11 or §53.16 of this chapter.

(g) "Equivalent method" means a method of sampling and analyzing the ambient air for an air pollutant that has been designated as an equivalent method in accordance with Part 53 of this chapter; it does not include a method for which an equivalent method designation has been cancelled in accordance with §53.11 or §53.16 of this chapter.

(h) "Traceable" means that a local standard has been compared and certified either directly or via not more than one intermediate standard, to a primary standard such as a National Bureau of Standards Standard Reference Material (NBS SRM), or a USEPA/NBS-approved Certified Reference Material (CRM).

[50.1 (h) added by 48 FR 2529, January 20, 1983]

§ 50.2 Scope.

(a) National primary and secondary ambient air quality standards under section 109 of the Act are set forth in this part.

(b) National primary ambient air quality standards define levels of air quality which the Administrator judges are necessary, with an adequate margin of safety, to protect the public health. National secondary ambient air quality standards define levels of air quality which the Administrator judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Such standards are subject to revision, and additional primary and secondary standards may be promulgated as the Administrator deems necessary to protect the public health and welfare.

(c) The promulgation of national primary and secondary ambient air quality standards shall not be considered in any manner to allow significant deterioration of existing air quality in any portion of any State.

(d) The proposal, promulgation, or revision of national primary and secondary ambient air quality standards shall not prohibit any State from establishing ambient air quality standards for that State or any portion thereof which are more stringent than the national standards.

§ 50.3 Reference conditions.

All measurements of air quality are corrected to a reference temperature of 25° C. and to a reference pressure of 760 millimeters of mercury (1,013.2 millibars).

§ 50.4 National primary ambient air quality standards for sulfur oxides (sulfur dioxide).

The national primary ambient air quality standards for sulfur oxides measured as sulfur dioxide by the reference method described in Appendix A to this part, or by an equivalent method, are:

(a) 80 micrograms per cubic meter (0.03 p.p.m.)—annual arithmetic mean.

(b) 365 micrograms per cubic meter (0.14 p.p.m.)—Maximum 24-hour concentration not to be exceeded more than once per year.

§ 50.5 National secondary ambient air quality standards for sulfur oxides (sulfur dioxide).

The national secondary ambient air quality standard for sulfur oxide measured as sulfur dioxide by the reference method described in Appendix A to this part, or by any equivalent method is 1,300 micrograms per cubic meter (0.5 p.p.m.) maximum 3-hour concentration not to be exceeded more than once per year.

§ 50.6 National primary ambient air quality standards for particulate matter.

The national primary ambient air quality standards for particulate matter, measured by the reference method described in Appendix B to this part, or by an equivalent method, are:

(a) 75 micrograms per cubic meter—annual geometric mean.

(b) 260 micrograms per cubic meter—maximum 24-hour concentration not to be exceeded more than once per year.

§ 50.7 National secondary ambient air quality standards for particulate matter.

The national secondary ambient air quality standards for particulate matter, measured by the reference method described in Appendix B to this part, or by an equivalent method, are:

(a) 60 micrograms per cubic meter—annual geometric mean, as a guide to

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Appendix B—Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)

[Appendix B revised by 47 FR 54899, December 6, 1982]

1.0 *Applicability.*

1.1 This method provides a measurement of the mass concentration of total suspended particulate matter (TSP) in ambient air for determining compliance with the primary and secondary national ambient air quality standards for particulate matter as specified in § 50.6 and § 50.7 of this chapter. The measurement process is nondestructive, and the size of the sample collected is usually adequate for subsequent chemical analysis. Quality assurance procedures and guidance are provided in Part 58. Appendixes A and B. of this chapter and in References 1 and 2.

2.0 *Principle.*

2.1 An air sampler, properly located at the measurement site, draws a measured quantity of ambient air into a covered housing and through a filter during a 24-hr (nominal) sampling period. The sampler flow rate and the geometry of the shelter favor the collection of particles up to 25–50 μm (aerodynamic diameter), depending on wind speed and direction.(3) The filters used are specified to have a minimum collection efficiency of 99 percent for 0.3 μm (DOP) particles (see Section 7.1.4).

2.2 The filter is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain. The total volume of air sampled, corrected to EPA standard conditions (25° C. 760 mm Hg [101 kPa]), is determined from the measured flow rate and the sampling time. The concentration of total suspended particulate matter in the ambient air is computed as the mass of collected particles divided by the volume of air sampled, corrected to standard conditions, and is expressed in micrograms per standard cubic meter (μg/std m^3). For samples collected at temperatures and pressures significantly different than standard conditions, these corrected concentrations may differ substantially from actual concentrations (micrograms per actual cubic meter), particularly at high elevations. The actual particulate matter concentration can be calculated from the corrected concentration using the actual temperature and pressure during the sampling period.

3.0 *Range.*

3.1 The approximate concentration range of the method is 2 to 750 μg/std m^3. The upper limit is determined by the point at which the sampler can no longer maintain the specified flow rate due to the increased pressure drop of the loaded filter. This point is affected by particle size distribution, moisture content of the collected particles, and variability from filter to filter, among other things. The lower limit is determined by the sensitivity of the balance (see Section 7.10) and by inherent sources of error (see Section 6).

3.2 At wind speeds between 1.3 and 4.5 m/sec (3 and 10 mph), the high-volume air sampler has been found to collect particles up to 25 to 50 μm, depending on wind speed and direction.(3) For the filter specified in Section 7.1, there is effectively no lower limit on the particle size collected.

4.0 *Precision.*

4.1 Based upon collaborative testing, the relative standard deviation (coefficient of variation) for single analyst precision (repeatability) of the method is 3.0 percent. The corresponding value for interlaboratory precision (reproducibility) is 3.7 percent.(4)

5.0 *Accuracy.*

5.1 The absolute accuracy of the method is undefined because of the complex nature of atmospheric particulate matter and the difficulty in determining the "true" particulate matter concentration. This method provides a measure of particulate matter concentration suitable for the purpose specified under Section 1.0, Applicability.

6.0 *Inherent Sources of Error.*

6.1 *Airflow variation.* The weight of material collected on the filter represents the (integrated) sum of the product of the instantaneous flow rate times the instantaneous particle concentration. Therefore, dividing this weight by the average flow rate over the sampling period yields the true particulate matter concentration only when the flow rate is constant over the period. The error resulting from a nonconstant flow rate depends on the magnitude of the instantaneous changes in the flow rate and in the particulate matter concentration. Normally, such errors are not large, but they can be greatly reduced by equipping the sampler with an automatic flow controlling mechanism that maintains constant flow during the sampling period. Use of a contant flow controller is recommended.*

6.2 *Air volume measurement.* If the flow rate changes substantially or nonuniformly during the sampling period, appreciable error in the estimated air volume may result from using the average of the presampling and postsampling flow rates. Greater air volume measurement accuracy may be achieved by (1) equipping the sampler with a flow controlling mechanism that maintains constant air flow during the sampling period,* (2) using a calibrated, continuous flow rate recording device to record the actual flow rate during the samping period and integrating the flow rate over the period, or (3) any other means that will accurately measure the total air volume sampled during the sampling period. Use of a continuous flow recorder is recommended, particularly if the sampler is not equipped with a constant flow controller.

6.3 *Loss of volatiles.* Volatile particles collected on the filter may be lost during subsequent sampling or during shipment and/or storage of the filter prior to the postsampling weighing.(*5*) Although such losses are largely unavoidable, the filter should be reweighed as soon after sampling as practical.

6.4 *Artifact particulate matter.* Artifact particulate matter can be formed on the surface of alkaline glass fiber filters by oxidation of acid gases in the sample air, resulting in a higher than true TSP determination.(*6 7*) This effect usually occurs early in the sample period and is a function of the filter pH and the presence of acid gases. It is generally believed to account for only a small percentage of the filter weight gain, but the effect may become more significant where relatively small particulate weights are collected.

6.5 *Humidity.* Glass fiber filters are comparatively insensitive to changes in relative humidity, but collected particulate matter can be hygroscopic.(*8*) The moisture conditioning procedure minimizes but may not completely eliminate error due to moisture.

6.6 *Filter handling.* Careful handling of the filter between the presampling and postsampling weighings is necessary to avoid errors due to loss of fibers or particles from the filter. A filter paper cartridge or cassette used to protect the filter can minimize handling errors. (See Reference 2, Section 2).

6.7 *Nonsampled particulate matter.* Particulate matter may be deposited on the filter by wind during periods when the sampler is inoperative. (*9*) It is recommended that errors from this source be minimized by an automatic mechanical device that keeps the filter covered during nonsampling periods, or by timely installation and retrieval of filters to minimize the nonsampling periods prior to and following operation.

6.8 *Timing errors.* Samplers are normally controlled by clock timers set to start and stop the sampler at midnight. Errors in the nominal 1,440-min sampling period may result from a power interruption during the sampling period or from a discrepancy between the start or stop time recorded on the filter information record and the actual start or stop time of the sampler. Such discrepancies may be caused by (1) poor resolution of the timer set-points, (2) timer error due to power interruption, (3) missetting of the timer, or (4) timer malfunction. In general, digital electronic timers have much better set-point resolution than mechanical timers, but require a battery backup system to maintain continuity of operation after a power interruption. A continuous flow recorder or elapsed time meter provides an indication of the sampler run-time, as well as indication of any power interruption during the sampling period and is therefore recommended.

6.9 *Recirculation of sampler exhaust.* Under stagnant wind conditions, sampler exhaust air can be resampled. This effect does not appear to affect the TSP measurement substantially, but may result in increased carbon and copper in the collected sample. (*10*) This problem can be reduced by ducting the exhaust air well away, preferably downwind, from the sampler.

7.0 *Apparatus.*

(See References 1 and 2 for quality assurance information.)

Note.—Samplers purchased prior to the effective date of this amendment are not subject to specifications preceded by (†).

7.1 *Filter.* (Filters supplied by the Environmental Protection Agency can be assumed to meet the following criteria. Additional specifications are required if the sample is to be analyzed chemically.)

7.1.1 *Size:* 20.3 ± 0.2 × 25.4 ± 0.2 cm (nominal 8 × 10 in).

7.1.2 *Nominal exposed area:* 406.5 cm² (63 in²).

7.1.3. *Material:* Glass fiber or other relatively inert, nonhygroscopic material. (*8*)

7.1.4 *Collection efficiency:* 99 percent minimum as measured by the DOP test (ASTM–2986) for particles of 0.3 μm diameter.

7.1.5 *Recommended pressure drop range:* 42–54 mm Hg (5.6–7.2 kPa) at a flow rate of 1.5 std m³/min through the nominal exposed area.

7.1.6 *pH:* 6 to 10. (*11*)

7.1.7 *Integrity:* 2.4 mg maximum weight loss. (*11*)

7.1.8 *Pinholes:* None.

7.1.9 *Tear strength:* 500 g minimum for 20 mm wide strip cut from filter in weakest dimension. (See ASTM Test D828–60).

7.1.10 *Brittleness:* No cracks or material separations after single lengthwise crease.

7.2 *Sampler.* The air sampler shall provide means for drawing the air sample, via reduced pressure, through the filter at a uniform face velocity.

7.2.1 The sampler shall have suitable means to:

a. Hold and seal the filter to the sampler housing.

b. Allow the filter to be changed conveniently.

c. Preclude leaks that would cause error in the measurement of the air volume passing through the filter.

d. (†) Manually adjust the flow rate to accommodate variations in filter pressure drop and site line voltage and altitude. The adjustment may be accomplished by an automatic flow controller or by a manual flow adjustment device. Any manual adjustment device must be designed with positive detents or other means to avoid unintentional changes in the setting.

7.2.2 *Minimum sample flow rate, heavily loaded filter:* 1.1 m³/min (39 ft³/min).**

7.2.3 *Maximum sample flow rate, clean filter:* 1.7 m³/min (60 ft³/min).**

7.2.4 *Blower Motor:* The motor must be capable of continuous operation for 24-hr periods.

7.3 *Sampler shelter.*

*At elevated altitudes, the effectiveness of automatic flow controllers may be reduced because of a reduction in the maximum sampler flow.

(†) See note at beginning of Section 7.

** These specifications are in actual air volume units; to convert to EPA standard air volume units, multiply the specifications by $(P_b/P_{std})(298/T)$ where P_b and T are the barometric pressure in mm Hg (or kPa) and the temperature in K at the sampler, and P_{std} is 760 mm Hg (or 101 kPa).

[Appendix B]

7.3.1 The sampler shelter shall:

Maintain the filter in a horizontal n at least 1 m above the sampler ting surface so that sample air is drawn downward through the filter.

b. Be rectangular in shape with a gabled oof, similar to the design shown in Figure 1.

c. Cover and protect the filter and sampler from precipitation and other weather.

d. Discharge exhaust air at least 40 cm from he sample air inlet.

e. Be designed to minimize the collection of dust from the supporting surface by incorporating a baffle between the exhaust outlet and the supporting surface.

7.3.2 The sampler cover or roof shall overhang the sampler housing somewhat, as shown in Figure 1, and shall be mounted so as to form an air inlet gap between the cover and the sampler housing walls. †This sample air inlet should be approximately uniform on all sides of the sampler. †The area of the sample air inlet must be sized to provide an effective particle capture air velocity of between 20 and 35 cm/sec at the recommended operational flow rate. The capture velocity is the sample air flow rate divided by the inlet area measured in a horizontal plane at the lower edge of the cover. †Ideally, the inlet area and operational flow rate should be selected to obtain a capture air velocity of 25 ±2 cm/sec.

7.4 *Flow rate measurement devices.*

7.4.1 The sampler shall incorporate a flow rate measurement device capable of indicating the total sampler flow rate. Two non types of flow indicators covered in alibration procedure are (1) an electronic mass flowmeter and (2) an orifice or orifices located in the sample air stream together with a suitable pressure indicator such as a manometer, or aneroid pressure gauge. A pressure recorder may be used with an orifice to provide a continuous record of the flow. Other types of flow indicators (including rotameters) having comparable precision and accuracy are also acceptable.

7.4.2 † The flow rate measurement device must be capable of being calibrated and read in units corresponding to a flow rate which is readable to the nearest 0.02 std m^3/min over the range 1.0 to 1.8 std m^3/min.

7.5 *Thermometer*, to indicate the approximate air temperature at the flow rate measurement orifice, when temperature corrections are used.

7.5.1 *Range:* −40° to ±50° C (223–323 K).

7.5.2 *Resolution:* 2° C (2 K).

7.6 *Barometer*, to indicate barometric pressure at the flow rate measurement orifice, when pressure corrections are used.

7.6.1 *Range:* 500 to 800 mm Hg (66–106 kPa).

7.6.2 *Resolution:* ±5 mm Hg (0.67 kPa).

7.7 *Timing/control device.*

7.7.1 The timing device must be capable of starting and stopping the sampler to obtain an elapsed run-time of 24 hr ±1 hr (1,440 ±60 min).

7.7.2 *Accuracy of time setting:* ±30 min. or better. (See Section 6.8).

7.8 *Flow rate transfer standard*, traceable to a primary standard. (See Section 9.2).

7.8.1 *Approximate range:* 1.0 to 1.8 m^3/min.

7.8.2 *Resolution:* 0.02 m^3/min.

7.8.3 *Reproducibility:* ±2 percent (2 times coefficient of variation) over normal ranges of ambient temperature and pressure for the stated flow rate range. (See Reference 2, Section 2.)

7.8.4 Maximum pressure drop at 1.7 std m^3/min: 50 cm H_2O (5 kPa).

7.8.5 The flow rate transfer standard must connect without leaks to the inlet of the sampler and measure the flow rate of the total air sample.

7.8.6 The flow rate transfer standard must include a means to vary the sampler flow rate over the range of 1.0 to 1.8 m^3/min (35–64 ft^3/min) by introducing various levels of flow resistance between the sampler and the transfer standard inlet.

7.8.7 The Conventional type of flow transfer standard consists of: An orifice unit with adapter that connects to the inlet of the sampler, a manometer or other device to measure orifice pressure drop, a means to vary the flow through the sampler unit, a thermometer to measure the ambient temperature, and a barometer to measure ambient pressure. Two such devices are shown in Figures 2a and 2b. Figure 2a shows multiple fixed resistance plates, which necessitate disassembly of the unit each time the flow resistance is changed. A preferable design, illustrated in Figure 2b, has a variable flow restriction that can be adjusted externally without disassembly of the unit. Use of conventional, orifice-type transfer standard is assumed in the calibration procedure (Section 9). However, the use of other types of transfer standards meeting the above specifications, such as the one shown in Figure 2c, may be approved; see the note following Section 9.1.

7.9 *Filter conditioning environment*

7.9.1 *Controlled temperature:* between 15° and 30° C with less than ± 3° C variation during equilibration period.

[Corrected by 48 FR 17355, April 22, 1983]

7.9.2 *Controlled humidity:* Less than 50 percent relative humidity, constant within ±5 percent.

7.10 *Analytical balance.*

7.10.1 *Sensitivity:* 0.1 mg.

7.10.2 Weighing chamber designed to accept an unfolded 20.3 x 25.4 cm (8 x 10 in) filter.

7.11 *Area light source*, similar to X-ray film viewer, to backlight filters for visual inspection.

7.12 *Numbering device*, capable of printing identification numbers on the filters before they are placed in the filter conditioning environment, if not numbered by the supplier.

8.0 *Procedure.*

(See References 1 and 2 for quality assurance information.)

8.1 Number each filter, if not already numbered, near its edge with a unique identification number.

8.2 Backlight each filter and inspect for pinholes, particles, and other imperfections: filters with visible imperfections must not be used.

8.3 Equilibrate each filter in the conditioning environment for at least 24-hr.

8.4 Following equilibration, weigh each filter to the nearest milligram and record this tare weight (W_i) with the filter identification number.

8.5 Do not bend or fold the filter before collection of the sample.

8.6 Open the shelter and install a numbered, preweighted filter in the sampler, following the sampler manufacturer's instructions. During inclement weather, precautions must be taken while changing filters to prevent damage to the clean filter and loss of sample from or damage to the exposed filter. Filter cassettes that can be loaded and unloaded in the laboratory may be used to minimize this problem (See Section 6.6).

[Corrected by 48 FR 17355, April 22, 1983]

8.7 Close the shelter and run the sampler for at least 5 min to establish run-temperature conditions.

8.8 Record the flow indicator reading and, if needed, the barometric pressure (P_3) and the ambient temperature (T_3) see NOTE following step 8.12). Stop the sampler. Determine the sampler flow rate (see Section 10.1); if it is outside the acceptable range (1.1 to 1.7 m^3/min (39–60 ft^3/min)), use a different filter, or adjust the sampler flow rate. Warning: Substantial flow adjustments may affect the calibration of the orifice-type flow indicators and may necessitate recalibration.

8.9 Record the sampler identification information (filter number, site location or identification number, sample date, and starting time).

8.10 Set the timer to start and stop the sampler such that the sampler runs 24-hrs, from midnight to midnight (local time).

[Corrected by 48 FR 17355, April 22, 1983]

(†) See note at beginning of Section 7.

†† These specifications are in actual air volume units; to convert to EPA standard air volume units, multiply the specifications by (P_b/P_{std})(298/T) where nd T are the barometric pressure in mm Hg (or) and the temperature in K at the sampler, and P_{std} is 760 mm Hg (or 101 kPa).

8.11 As soon as practical following the sampling period, run the sampler for at least 5 min to again establish run-temperature conditions.

8.12 Record the flow indicator reading and, if needed, the barometric Pressure (P_3) and the ambient temperature (T_3).

Note.—No onsite pressure or temperature measurements are necessary if the sampler flow indicator does not require pressure or temperature corrections (e.g., a mass flowmeter) or if average barometric pressure and seasonal average temperature for the site are incorporated into the sampler calibration (see step 9.3.9). For individual pressure and temperature corrections, the ambient pressure and temperature can be obtained by onsite measurements or from a nearby weather station. Barometric pressure readings obtained from airports must be station pressure, not corrected to sea level, and may need to be corrected for differences in elevation between the sampler site and the airport. For samplers having flow recorders but not constant flow controllers, the average temperature and pressure at the site *during the sampling period* should be estimated from weather bureau or other available data.

8.13 Stop the sampler and carefully remove the filter, following the sampler manufacturer's instructions. Touch only the outer edges of the filter. See the precautions in step 8.6.

8.14 Fold the filter in half lengthwise so that only surfaces with collected particulate matter are in contact and place it in the filter holder (glassine envelope or manila folder).

8.15 Record the ending time or elapsed time on the filter information record, either from the stop set-point time, from an elapsed time indicator, or from a continuous flow record. The sample period must be 1,440 ± 60 min. for a valid sample.

8.16 Record on the filter information record any other factors, such as meteorological conditions, construction activity, fires or dust storms, etc., that might be pertinent to the measurement. If the sample is known to be defective, void it at this time.

8.17 Equilibrate the exposed filter in the conditioning environment for at least 24-hrs.

8.18 Immediately after equilibration, reweigh the filter to the nearest milligram and record the gross weight with the filter identification number. See Section 10 for TSP concentration calculations.

9.0 *Calibration.*

9.1 Calibration of the high volume sampler's flow indicating or control device is necessary to establish traceability of the field measurement to a primary standard via a flow rate transfer standard. Figure 3a illustrates the certification of the flow rate transfer standard and Figure 3b illustrates its use in calibrating a sampler flow indicator. Determination of the corrected flow rate from the sampler flow indicator, illustrated in Figure 3c, is addressed in Section 10.1

Note.—The following calibration procedure applies to a conventional orifice-type flow transfer standard and an orifice-type flow indicator in the sampler (the most common types). For samplers using a pressure recorder having a square-root scale, 3 other acceptable calibration procedures are provided in Reference 12. Other types of transfer standards may be used if the manufacturer or user provides an appropriately modified calibration procedure that has been approved by EPA under Section 2.8 of Appendix C to Part 58 of this chapter.

9.2 *Certification of the flow rate transfer standard.*

9.2.1 *Equipment required:* Positive displacement standard volume meter traceable to the National Bureau of Standards (such as a Roots meter or equivalent), stop-watch, manometer, thermometer, and barometer.

9.2.2 Connect the flow rate transfer standard to the inlet of the standard volume meter. Connect the manometer to measure the pressure at the inlet of the standard volume meter. Connect the orifice manometer to the pressure tap on the transfer standard. Connect a high-volume air pump (such as a high-volume sampler blower) to the outlet side of the standard volume meter. See Figure 3a.

9.2.3 Check for leaks by temporarily clamping both manometer lines (to avoid fluid loss) and blocking the orifice with a large-diameter rubber stopper, wide cellophane tape, or other suitable means. Start the high-volume air pump and note any change in the standard volume meter reading. *The reading should remain constant.* If the reading changes, locate any leaks by listening for a whistling sound and/or retightening all connections, making sure that all gaskets are properly installed.

9.2.4 After satisfactorily completing the leak check as described above, unclamp both manometer lines and zero both manometers.

9.2.5 Achieve the appropriate flow rate through the system, either by means of the variable flow resistence in the transfer standard or by varying the voltage to the air pump. (Use of resistance plates as shown in Figure 1a is discouraged because the above leak check must be repeated each time a new resistance plate is installed.) At least five different but constant flow rates, even distributed, with at least three in the specified flow rate interval (1.1 to 1.7 m³/min [39–60 ft³/min]), are required.

9.2.6 Measure and record the certification data on a form similar to the one illustrated in Figure 4 according to the following steps.

9.2.7 Observe the barometric pressure and record as P_1 (item 8 in Figure 4).

9.2.8 Read the ambient temperature in the vicinity of the standard volume meter and record it as T_1 (item 9 in Figure 4).

9.2.9 Start the blower motor, adjust the flow, and allow the system to run for at least 1 min for a constant motor speed to be attained.

9.2.10 Observe the standard volume meter reading and simultaneously start a stopwatch. Record the initial meter reading (V_i) in column 1 of Figure 4.

9.2.11 Maintain this constant flow rate until at least 3 m³ of air have passed through the standard volume meter. Record the standard volume meter inlet pressure manometer reading as ΔP (column 5 in Figure 4), and the orifice manometer reading as ΔH (column 7 in Figure 4). Be sure to indicate the correct units of measurement.

9.2.12 After at least 3 m³ of air have passed through the system, observe the standard volume meter reading while simultaneously stopping the stopwatch. Record the final meter reading (V_f) in column 2 and the elapsed time (t) in column 3 of Figure 4.

9.2.13 Calculate the volume measured by the standard volume meter at meter conditions of temperature and pressures as $V_m = V_f - V_i$. Record in column 4 of Figure 4.

9.2.14 Correct this volume to standard volume (std m³) as follows:

$$V_{std} = V_m \frac{P_1 - \Delta P}{P_{std}} \frac{T_{std}}{T_1}$$

where:

V_{std} = standard volume, std m³;

V_m = actual volume measured by the standard volume meter;

P_1 = barometric pressure during calibration, mm Hg or kPa;

ΔP = differential pressure at inlet to volume meter, mm Hg or kPa;

P_{std} = 760 mm Hg or 101 kPa;

T_{std} = 298 K;

T_1 = ambient temperature during calibration, K.

Calculate the standard flow rate (std m³/min) as follows:

$$Q_{std} = \frac{V_{std}}{t}$$

where:

Q_{std} = standard volumetric flow rate, std m³/min

t = elapsed time, minutes.

Record Q_{std} to the nearest 0.01 std m³/min in column 6 of Figure 4.

9.2.15 Repeat steps 9.2.9 through 9.2.14 for at least four additional constant flow rates, evenly spaced over the approximate range of 1.0 to 1.8 std m³/min (35–64 ft³/min).

9.2.16 For each flow, compute

$$\sqrt{\Delta H\,(P_1/P_{std})(298/T_1)}$$

(column 7a of Figure 4) and plot these value against Q_{std} as shown in Figure 3a. Be sure to use consistent units (mm Hg or kPa) for rometric pressure. Draw the orifice transfer ·ard certification curve or calculate the :ast squares slope (m) and intercept (b, .he certification curve:

$$\sqrt{\Delta H (P_1/P_{std})(298/T_1)}$$

$= mQ_{std} + b$. See Figures 3 and 4. A rtification graph should be readable to 0.02 d m³/min.

9.2.17 Recalibrate the transfer standard annually or as required by applicable quality ontrol procedures. (See Reference 2.)

9.3 *Calibration of sampler flow indicator.*

Note.—For samplers equipped with a flow controlling device, the flow controller must be disabled to allow flow changes during libration of the sampler's flow indicator, or e alternate calibration of the flow controller given in 9.4 may be used. For samplers using an orifice-type flow indicator downstream of e motor, do not vary the flow rate by ljusting the voltage or power supplied to the ..mpler.

9.3.1 A form similar to the one illustrated ·· Figure 5 should be used to record the libration data.

9.3.2 Connect the transfer standard to the inlet of the sampler. Connect the orifice manometer to the orifice pressure tap, as lustrated in Figure 3b. Make sure there are o leaks between the orifice unit and the sampler.

9.3.3 . Operate the sampler for at least 5 ·tes to establish thermal equilibrium prior calibration.

..4 Measure and record the ambient temperature, T_2, and the barometric pressure, P_2, during calibration.

9.3.5 Adjust the variable resistance or, if pplicable, insert the appropriate resistance plate (or no plate) to achieve the desired flow rate.

9.3.6 Let the sampler run for at least 2 min o re-establish the run-temperature conditions. Read and record the pressure drop across the orifice (ΔH) and the sampler flow rate indication (I) in the appropriate columns of Figure 5.

9.3.7 Calculate $\sqrt{\Delta H(P_2/P_{std})(298/T_2)}$ and determine the flow rate at standard conditions (Q_{std}) either graphically from the certification curve or by calculating Q_{std} from the least square slope and intercept of the transfer standard's transposed certification curve: $Q_{std} = 1/m \sqrt{\Delta H(P_2/P_{std})(298/T_2)} - b$. Record the value of Q_{std} on Figure 5.

[Corrected by 48 FR 17355, April 22, 1983]

9.3.8 Repeat steps 9.3.5, 9.3.6, and 9.3.7 for several additional flow rates distributed over a range that includes 1.1 to 1.7 std m³/min.

9.3.9 Determine the calibration curve by plotting values of the appropriate expression involving I, selected from Table 1, against Q_{std}. The choice of expression from Table 1 depends on the flow rate measurement device used (see Section 7.4.1) and also on whether the calibration curve is to incorporate geographic average barometric pressure (P_a) and seasonal average temperature (T_a) for the site to approximate actual pressure and temperature. Where P_a and T_a can be determined for a site for a seasonal period such that the actual barometric pressure and temperature at the site do not vary by more than ±60 mm Hg (8 kPa) from P_a or ±15° C from T_a, respectively, then using P_a and T_a avoids the need for subsequent pressure and temperature calculation when the sampler is used. The geographic average barometric pressure (P_a) may be estimated from an altitude-pressure table or by making an (approximate) elevation correction of −26 mm Hg (−3.46 kPa) for each 305 m (1,000 ft) above sea level (760 mm Hg or 101 kPa). The seasonal average temperature (T_a) may be estimated from weather station or other records. Be sure to use consistent units (mm Hg or kPa) for barometric pressure.

[Corrected by 48 FR 17355, April 22, 1983]

9.3.10 Draw the sampler calibration curve or calculate the linear least squares slope (m), intercept (b), and correlation coefficient of the calibration curve: [Expression from Table 1] = $mQ_{std} + b$. See Figures 3 and 5. Calibration curves should be readable to 0.02 std m³/min.

9.3.11 For a sampler equipped with a flow controller, the flow controlling mechanism should be re-enabled and set to a flow near the lower flow limit to allow maximum control range. The sample flow rate should be verified at this time with a clean filter installed. Then add two or more filters to the sampler to see if the flow controller maintains a constant flow; this is particularly important at high altitudes where the range of the flow controller may be reduced.

9.4 Alternate calibration of flow-controlled samplers. A flow-controlled sampler may be calibrated solely at its controlled flow rate, provided that previous operating history of the sampler demonstrates that the flow rate is stable and reliable. In this case, the flow indicator may remain uncalibrated but should be used to indicate any relative change between initial and final flows, and the sampler should be recalibrated more often to minimize potential loss of samples because of controller malfunction.

9.4.1 Set the flow controller for a flow near the lower limit of the flow range to allow maximum control range.

9.4.2 Install a clean filter in the sampler and carry out steps 9.3.2, 9.3.3, 9.3.4, 9.3.6, and 9.3.7.

9.4.3 Following calibration, add one or two additional clean filters to the sampler, reconnect the transfer standard, and operate the sampler to verify that the controller maintains the same calibrated flow rate; this is particularly important at high altitudes where the flow control range may be reduced.

TABLE 1. EXPRESSIONS FOR PLOTTING SAMPLER CALIBRATION CURVES

Type of sampler flow rate measuring device	Expression: For actual pressure and temperature corrections	Expression: For incorporation of geographic average pressure and seasonal average temperature
Mass flowmeter	I	I
Orifice and pressure indicator	$\sqrt{I\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)}$	$\sqrt{I\left(\frac{P_2}{P_a}\right)\left(\frac{T_a}{T_2}\right)}$
Rotameter, or orifice and pressure recorder having square root scale*	$I\sqrt{\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)}$	$I\sqrt{\left(\frac{P_2}{P_a}\right)\left(\frac{T_a}{T_2}\right)}$

*This scale is recognizable by its nonuniform divisions and is the most commonly available for high-volume samplers.

TABLE 2. EXPRESSIONS FOR DETERMINING FLOW RATE DURING SAMPLER OPERATION

Type of sampler flow rate measuring device	Expression: For actual pressure and temperature corrections	Expression: For use when geographic average pressure and seasonal average temperature have been incorporated into the sampler calibration
Mass flowmeter	I	I
Orifice and pressure indicator	$\sqrt{I\left(\frac{P_3}{P_{std}}\right)\left(\frac{298}{T_3}\right)}$	$\sqrt{I}$
Rotameter, or orifice and pressure recorder having square root scale*	$I\sqrt{\left(\frac{P_3}{P_{std}}\right)\left(\frac{298}{T_3}\right)}$	I

*This scale is recognizable by its nonuniform divisions and is the most commonly available for high-volume samplers.

...iculations of TSP Concentration
... ermine the average sampler flow ... the sampling period according to ...9.1.1 or 10.1.2 below.

1 For a sampler without a continuous recorder, determine the appropriate expression to be used from Table 2 ...onding to the one from Table 1 used in ...9. Using this appropriate expression, ...ine Q_{std} for the initial flow rate from sampler calibration curve, either ...phically or from the transposed regression ...on:

=

(...ppropriate expression from Table 2) − b)

...larly, determine Q_{std} from the final flow ...ading, and calculate the average flow Q_{std} ... one-half the sum of the initial and final ...ates.

...1.2 For a sampler with a continuous ...w recorder, determine the average flow ...evice reading, I, for the period. ...mine the appropriate expression from ...2 corresponding to the one from Table ...ed in step 9.3.9. Then using this ...xpression and the average flow rate reading, ...mine Q_{std} from the sampler calibration ..., either graphically or from the ...isposed regression equation:

...

(Appropriate expression from Table 2) − b)

...he trace shows substantial flow change ...g the sampling period, greater accuracy ...be achieved by dividing the sampling ...iod into intervals and calculating an ...erage reading before determining Q_{std}.

...2 Calculate the total air volume ...pled as:

$$V = Q_{std} \times t$$

where:

V = total air volume sampled, in standard volume units, std m³/;

Q_{std} = average standard flow rate, std m³/min:

t = sampling time, min.

[Corrected by 48 FR 17355, April 22, ...3]

10.3 Calculate and report the particulate matter concentration as:

$$TSP = \frac{(W_f - W_i) \times 10^6}{V}$$

where:

TSP = mass concentration of total suspended particulate matter, µg/std m³;

W_i = initial weight of clean filter, g;

W_f = final weight of exposed filter, g;

V = air volume sampled, converted to standard conditions, std m³,

10^6 = conversion of g to µg.

10.4 If desired, the actual particulate matter concentration (see Section 2.2) can be calculated as follows:

$$(TSP)_a = TSP\,(P_3/P_{std})(298/T_3)$$

where:

$(TSP)_a$ = actual concentration at field conditions, µg/m³;

TSP = concentration at standard conditions, µg/std m³;

P_3 = average barometric pressure during sampling period, mm Hg;

P_{std} = 760 mn Hg (or 101 kPa);

T_3 = average ambient temperature during sampling period, K.

11.0 *References.*

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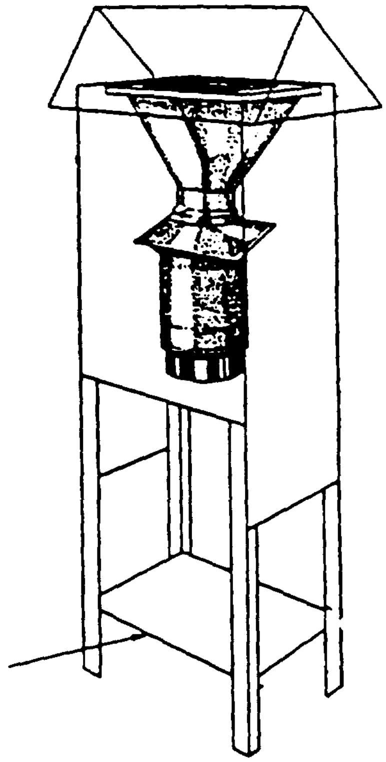

Figure 1. High-volume sampler in shelter.

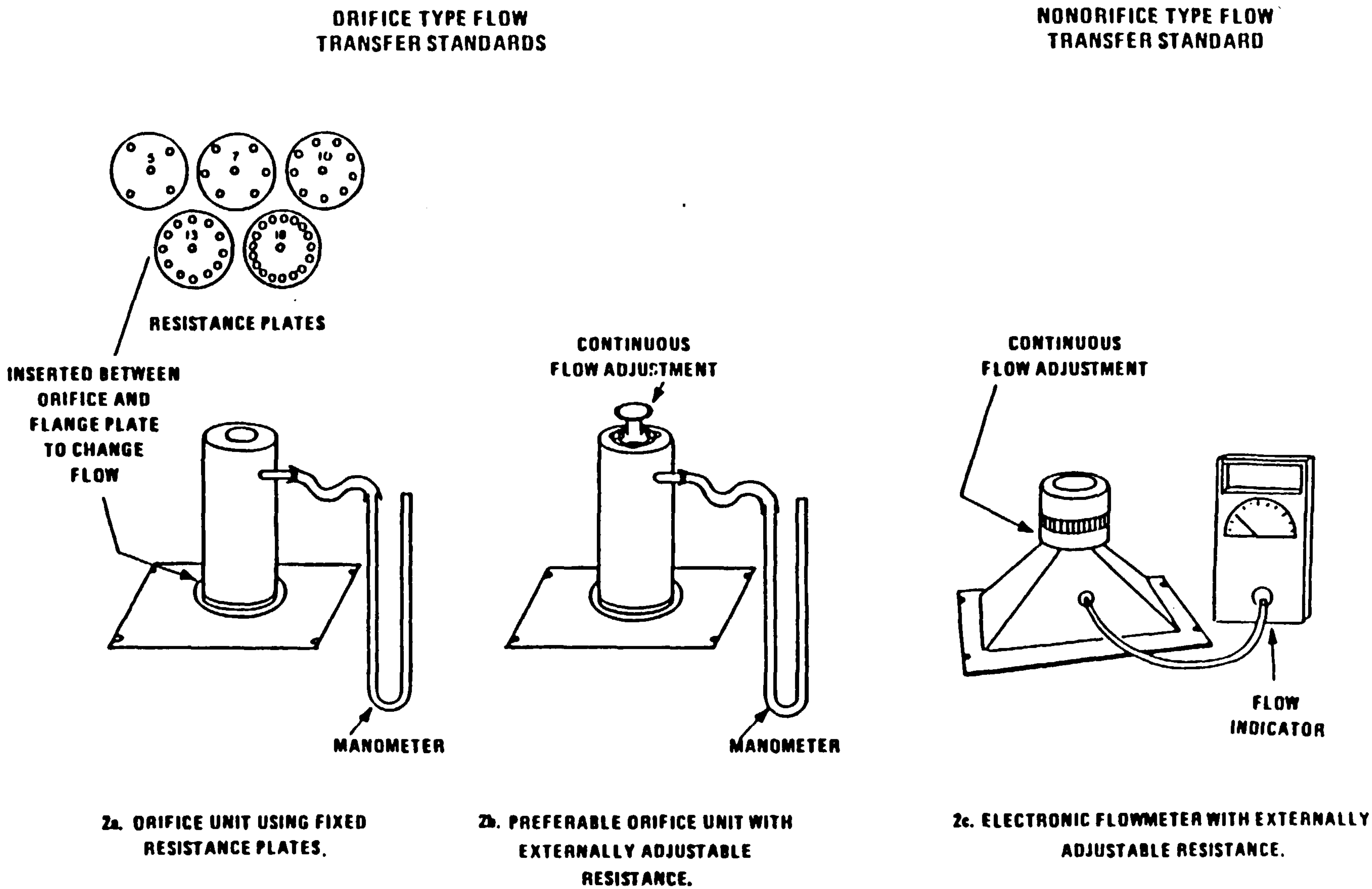

Figure 2. Various types of flow transfer standards. Note that all devices are designed to mount to the filter inlet area of the sampler.

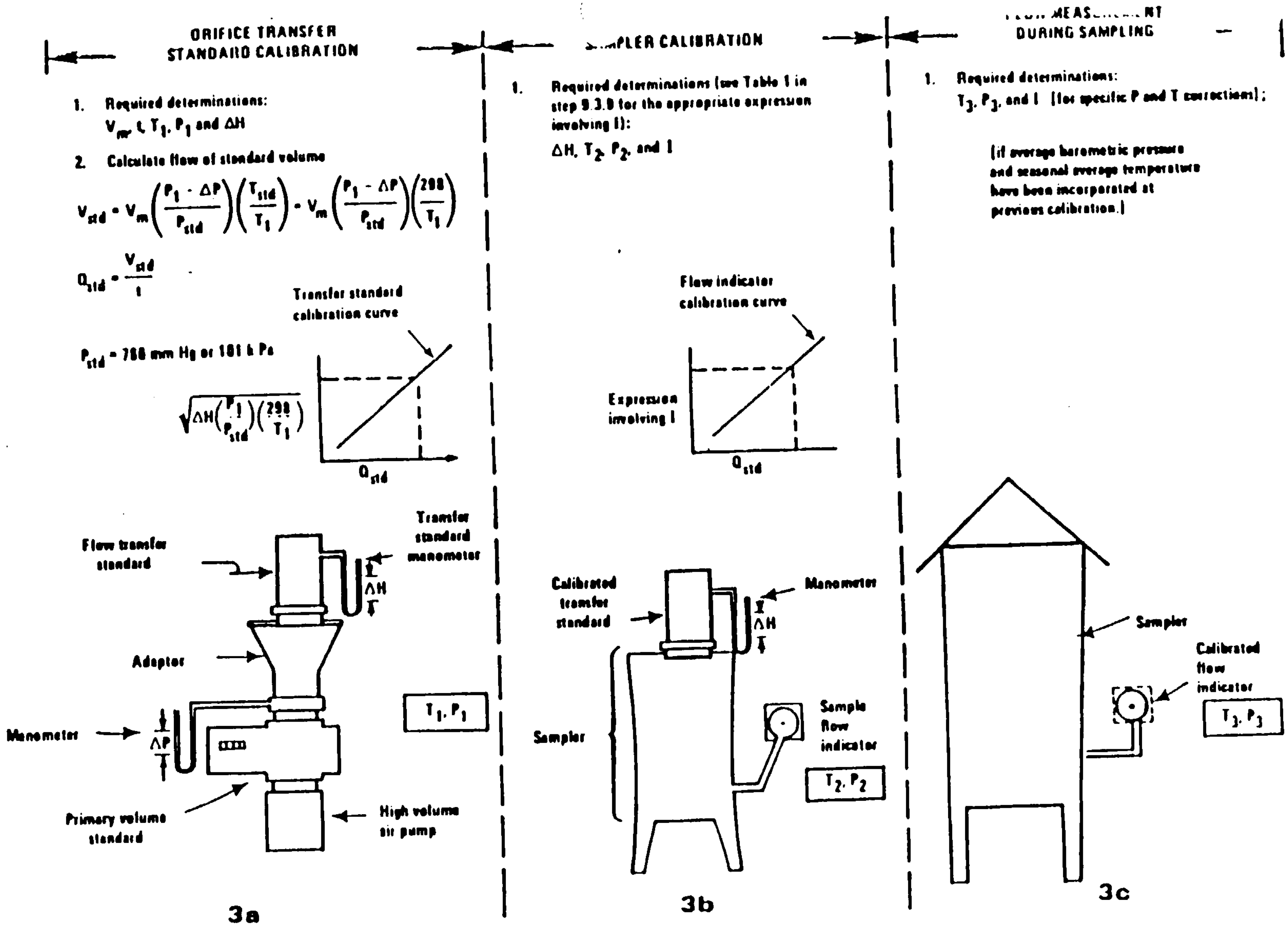

Figure 3. Illustration of the 3 steps in the flow measurement process.

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET

Run No.	(1) Meter reading start V_i (m^3)	(2) Meter reading stop V_f (m^3)	(3) Sampling time t (min)	(4) Volume measured V_m (m^3)	(5) Differential pressure (at inlet to volume meter) ΔP (mm Hg or kPa)	(6) (X) Flow rate Q_{std} (std m^3/min)	(7) Pressure drop across orifice ΔH ☐ (in) or ☐ (cm) of water	(7a) (Y) $\sqrt{\Delta H\left(\frac{P_1}{P_{std}}\right)\left(\frac{298}{T_1}\right)}$
1								
2								
3								
4								
5								
6								

RECORDED CALIBRATION DATA

Standard volume meter no. ______________________

Transfer standard type: ☐ orifice ☐ other

Model No. ______________ Serial No. ______________

(8) P_1: ______________ mm Hg (or kPa) (10) P_{std}: 760 mm Hg (or 101 kPa)

(9) T_1: ______________ K (11) T_{std}: 298 K

Calibration performed by: ______________________

Date: ______________

CALCULATION EQUATIONS

(1) $V_m = V_f - V_i$

(2) $V_{std} = V_m\left(\frac{P_1 - \Delta P}{P_{std}}\right)\left(\frac{T_{std}}{T_1}\right)$

(3) $Q_{std} = \frac{V_{std}}{t}$

LEAST SQUARES CALCULATIONS

Linear ($Y = mX + b$) regression equation of $Y = \sqrt{\Delta H(P_1/P_{std})(298/T_1)}$ on $X = Q_{std}$ for Orifice Calibration Unit (i.e., $\sqrt{\Delta H(P_1/P_{std})(298/T_1)} = mQ_{std} + b$)

Slope (m) = ______________ Intercept (b) = ______________ Correlation coefficient (r) = ______________

To use for subsequent calibration: $X = \frac{1}{m}(Y-b)$; $\boxed{Q_{std} = \frac{1}{m}\left(\sqrt{\Delta H\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)} - b\right)}$

Figure 4. Example of orifice transfer standard certification worksheet.

HIGH-VOLUME AIR SAMPLER CA[illegible]TION WORKSHEET

Site Location: ______________________

Date: ____________ Barometric Pressure, P_2 mm Hg (or kPa) ____________

Calibrated By: ____________ Temperature, T_2 (K) ____________

Sampler No. ____________ Serial No. ____________

Transfer std. type: ____________ Serial No. ____________

P_{std} = 760 mm Hg (or 101 kPa)

Optional:

Average barometric pressure: P_a = ____________

Seasonal average temperature: T_a = ____________

No.	ΔH Pressure drop across orifice ☐ (in) or ☐ (cm) of water	$\sqrt{\Delta H\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)}$	(X) Q_{std} (from orifice certification) std m³/min	I Sampler flow rate indication (arbitrary)	(Y) For specific pressure and temperature corrections (see Table 1): ☐ I or ☐ $\sqrt{I\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)}$ or ☐ $I\sqrt{\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)}$	For incorporation of average pressure and seasonal average temperature (see Table 1): ☐ I or ☐ $\sqrt{I\left(\frac{P_2}{P_a}\right)\left(\frac{T_a}{T_2}\right)}$ or ☐ $I\sqrt{\left(\frac{P_2}{P_a}\right)\left(\frac{T_a}{T_2}\right)}$
1						
2						
3						
4						
5						
6						

LEAST SQUARES CALCULATIONS

Linear regression of Y on X: $Y = mX + b$; Y = appropriate expression from Table 1; $X = Q_{std}$.

Slope (m) = ____ Intercept (b) = ____ Correlation Coeff. (r) = ________

To determine subsequent flow rate during use: $X = \frac{1}{m}(Y-b)$; $\boxed{Q_{std} = \frac{1}{m}([\text{appropriate expression from Table 2}] - b)}$

Figure 5. Example of high-volume air sampler calibration worksheet.

toring and Support Laboratory, Research Triangle Park, North Carolina 27711).

[References 14 and 15 added by 48 FR 2529, January 20, 1983]

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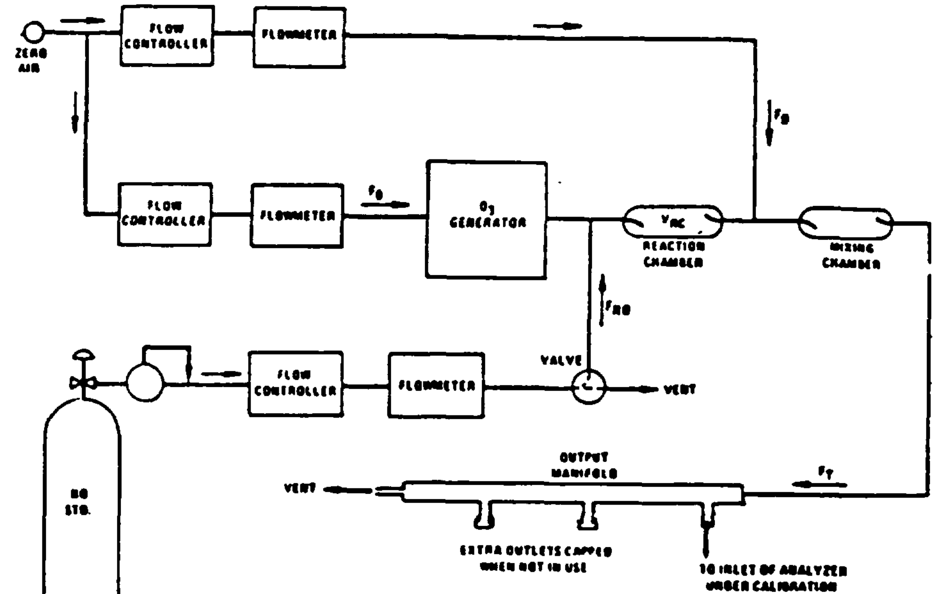

Figure 1. Schematic diagram of a typical GPT calibration system.

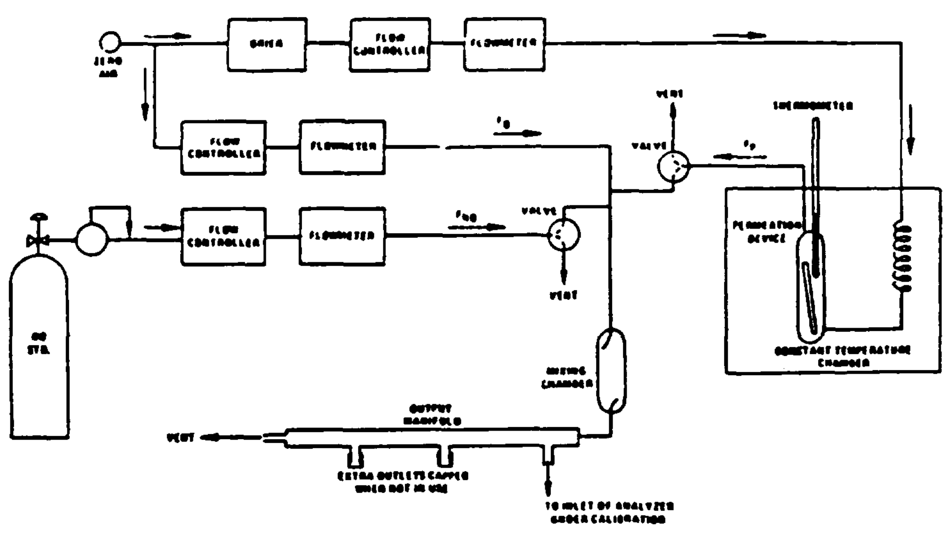

Figure 2. Schematic diagram of a typical calibration apparatus using an NO2 permeation device.

APPENDIX G—REFERENCE METHOD FOR THE DETERMINATION OF LEAD IN SUSPENDED PARTICULATE MATTER COLLECTED FROM AMBIENT AIR

1. *Principle and applicability.*

1.1 Ambient air suspended particulate matter is collected on a glass-fiber filter for 24 hours using a high volume air sampler. The analysis of the 24-hour samples may be performed for either individual samples or composites of the samples collected over a calendar month or quarter, provided that the compositing procedure has been approved in accordance with section 2.8 of Appendix C to Part 58 of this chapter — *Modifications of methods by users.* (Guidance or assistance in requesting approval under Section 2.8 can be obtained from the address given in section 2.7 of Appendix C to Part 58 of this chapter.)

[Section 1.1 amended by 46 FR 44163, September 3, 1981]

1.2 Lead in the particulate matter is solubilized by extraction with nitric acid (HNO_3), facilitated by heat or by a mixture

[Appendix G]

of HNO_3 and hydrochloric acid (HCl) facilitated by ultrasonication.

1.3 The lead content of the sample is analyzed by atomic absorption spectrometry using an air-acetylene flame, the 283.3 or 217.0 nm lead absorption line, and the optimum instrumental conditions recommended by the manufacturer.

1.4 The ultrasonication extraction with HNO_3/HCl will extract metals other than lead from ambient particulate matter.

2. *Range, sensitivity, and lower detectable limit.* The values given below are typical of the methods capabilities. Absolute values will vary for individual situations depending on the type of instrument used, the lead line, and operating conditions.

2.1 Range. The typical range of the method is 0.07 to 7.5 µg Pb/m³ assuming an upper linear range of analysis of 15 µg/ml and an air volume of 2,400 m³.

2.2 *Sensitivity.* Typical sensitivities for a 1 percent change in absorption (0.0044 absorbance units) are 0.2 and 0.5 µg Pb/ml for the 217.0 and 283.3 nm lines, respectively.

2.3 Lower detectable limit (LDL). A typical LDL is 0.07 µg Pb/m³. The above value was calculated by doubling the between-laboratory standard deviation obtained for the lowest measurable lead concentration in a collaborative test of the method.(*15*) An air volume of 2,400 m³ was assumed.

3. *Interferences.* Two types of interferences are possible: chemical and light scattering.

3.1 *Chemical.* Reports on the absence (*1, 2, 3, 4, 5*) of chemical interferences far outweigh those reporting their presence, (*6*) therefore, no correction for chemical interferences is given here. If the analyst suspects that the sample matrix is causing a chemical interference, the interference can be verified and corrected for by carrying out the analysis with and without the method of standard additions.(*7*)

3.2 Light scattering. Nonatomic absorption or light scattering, produced by high concentrations of dissolved solids in the sample, can produce a significant interference, especially at low lead concentrations. (*2*) The interference is greater at the 217.0 nm line than at the 283.3 nm line. No interference was observed using the 283.3 nm line with a similar method.(*1*)

Light scattering interferences can, however, be corrected for instrumentally. Since the dissolved solids can vary depending on the origin of the sample, the correction may be necessary, especially when using the 217.0 nm line. Dual beam instruments with a continuum source give the most accurate correction. A less accurate correction can be obtained by using a nonabsorbing lead line that is near the lead analytical line. Information on use of these correction techniques can be obtained from instrument manufacturers' manuals.

If instrumental correction is not feasible, the interference can be eliminated by use of the ammonium pyrrolidinecarbodithioate-methylisobutyl ketone, chelation-solvent extraction technique of sample preparation.(*8*)

4. *Precision and bias.*

4.1 The high-volume sampling procedure used to collect ambient air particulate matter has a between-laboratory relative standard deviation of 3.7 percent over the range 80 to 125 µg/m³.(*9*) The combined extraction-analysis procedure has an average within-laboratory relative standard deviation of 5 to 6 percent over the range 1.5 to 15 µg Pb/ml, and an average between laboratory relative standard deviation of 7 to 9 percent over the same range. These values include use of either extraction procedure.

4.2 Single laboratory experiments and collaborative testing indicate that there is no significant difference in lead recovery between the hot and ultrasonic extraction procedures.(*15*)

5. *Apparatus.*

5.1 Sampling.

5.1.1 High-volume sampler. Use and calibrate the sampler as described in reference 10.

5.2 Analysis.

5.2.1 Atomic absorption spectrophotometer. Equipped with lead hollow cathode or electrodeless discharge lamp.

5.2.1.1 Acetylene. The grade recommended by the instrument manufacturer should be used. Change cylinder when pressure drops below 50-100 psig.

5.2.1.2 Air. Filtered to remove particulate, oil, and water.

5.2.2 Glassware. Class A borosilicate glassware should be used throughout the analysis.

5.2.2.1 Beakers. 30 and 150 ml. graduated, Pyrex.

5.2.2.2 Volumetric flasks. 100-ml.

5.2.2.3 Pipettes. To deliver 50, 30, 15, 8, 4, 2, 1 ml.

5.2.2.4 Cleaning. All glassware should be scrupulously cleaned. The following procedure is suggested. Wash with laboratory detergent, rinse, soak for 4 hours in 20 percent (w/w) HNO_3, rinse 3 times with distilled-deionized water, and dry in a dust free manner.

5.2.3 Hot plate.

5.2.4. Ultrasonication water bath, unheated. Commercially available laboratory ultrasonic cleaning baths of 450 watts or higher "cleaning power," i.e., actual ultrasonic power output to the bath have been found satisfactory.

5.2.5 Template. To aid in sectioning the glass-fiber filter. See figure 1 for dimensions.

5.2.6 Pizza cutter. Thin wheel. Thickness <1mm.

5.2.7 Watch glass.

5.2.8 Polyethylene bottles. For storage of samples. Linear polyethylene gives better storage stability than other polyethylenes and is preferred.

5.2.9 Parafilm "M".* American Can Co., Marathon Products, Nennah, Wis., or equivalent.

6. *Reagents.*

6.1 Sampling.

6.1.1 Glass fiber filters. The specifications given below are intended to aid the user in obtaining high quality filters with reproducible properties. These specifications have been met by EPA contractors.

6.1.1.1 Lead content. The absolute lead content of filters is not critical, but low values are, of course, desirable. EPA typically obtains filters with a lead content of <75 µg/filter.

It is important that the variation in lead content from filter to filter, within a given batch, be small.

6.1.1.2 Testing.

6.1.1.2.1 For large batches of filters (>500 filters) select at random 20 to 30 filters from a given batch. For small batches (<500 filters) a lesser number of filters may be taken. Cut one ¾"x8" strip from each filter anywhere in the filter. Analyze all strips, separately, according to the directions in sections 7 and 8.

6.1.1.2.2 Calculate the total lead in each filter as

$$F_b = \mu g\ Pb/ml \times \frac{100\ ml}{strip} \times \frac{12\ strips}{filter}$$

where:

F_b = Amount of lead per 72 square inches of filter, µg.

6.1.1.2.3 Calculate the mean, $\bar{F}_b$, of the values and the relative standard deviation (standard deviation/mean × 100). If the relative standard deviation is high enough so that, in the analysts opinion, subtraction of $\bar{F}_b$ (section 10.3) may result in a significant error in the µg Pb/m³ the batch should be rejected.

6.1.1.2.4 For acceptable batches, use the value of $\bar{F}_b$ to correct all lead analyses (section 10.3) of particulate matter collected using that batch of filters. If the analyses are below the LDL (section 2.3) no correction is necessary.

6.2 Analysis.

6.2.1 Concentrated (15.6 *M*) HNO_3. ACS reagent grade HNO_3 and commercially available redistilled HNO_3 has found to have sufficiently low lead concentrations.

6.2.2 Concentrated (11.7 *M*) HCl. ACS reagent grade.

6.2.3 Distilled-deionized water. (D.I. water).

6.2.4 3 *M* HNO_3. This solution is used in the hot extraction procedure. To prepare, add 192 ml of concentrated HNO_3 to D.I. water in a 1 *l* volumetric flask. Shake well, cool, and dilute to volume with D.I. water. *Caution:* Nitric acid fumes are toxic. Prepare in a well ventilated fume hood.

6.2.5 0.45 *M* HNO_3. This solution is used as the matrix for calibration standards when using the hot extraction procedure. To prepare, add 29 ml of concentrated HNO_3 to D.I. water in a 1 *l* volumetric flask. Shake well, cool, and dilute to volume with D.I. water.

6.2.6 2.6 *M* HNO_3+0 to 0.9 *M* HCl. This solution is used in the ultrasonic extraction procedure. The concentration of HCl can be varied from 0 to 0.9 *M*. Directions are given for preparation of a 2.6 *M* HNO_3+0.9 *M* HCl solution. Place 167 ml of concentrated HNO_3 into a 1 *l* volumetric flask and add 77 ml of concentrated HCl. Stir 4 to 6 hours, dilute to nearly 1 *l* with D.I. water, cool to room temperature, and dilute to 1 *L*.

6.2.7 0.40 *M* HNO_3 + X *M* HCl. This solution is used as the matrix for calibration standards when using the ultrasonic extraction procedure. To prepare, add 26 ml of concentrated HNO_3, plus the ml of HCl required, to a 1 *l* volumetric flask. Dilute to nearly 1 *l* with D.I. water, cool to room temperature, and dilute to 1 *L*. The amount of HCl required can be determined from the following equation:

$$y = \frac{77\ ml \times 0.15\ x}{0.9\ M}$$

*Mention of commercial products does not imply endorsement by the U.S. Environmental Protection Agency.

[Appendix G]

where:

y = ml of concentrated HCl required.
x = molarity of HCl in 6.2.6.
0.15 = dilution factor in 7.2.2.

6.2.8 Lead nitrate, $Pb(NO_3)_2$, ACS reagent grade, purity 99.0 percent. Heat for 4 hours at 120° C and cool in a desiccator.

6.3 Calibration standards.

6.3.1 Master standard, 1000 μg Pb/ml in HNO_3. Dissolve 1.598 g of $Pb(NO_3)_2$ in 0.45 *M* HNO_3 contained in a 1 *l* volumetric flask and dilute to volume with 0.45 *M* HNO_3.

6.3.2 Master standard, 1000 μg Pb/ml in HNO_3/HCl. Prepare as in 6.3.1 except use the HNO_3/HCl solution in 6.2.7.

Store standards in a polyethylene bottle. Commercially available certified lead standard solutions may also be used.

7. *Procedure.*

7.1 Sampling. Collect samples for 24 hours using the procedure described in *reference 10* with glass-fiber filters meeting the specifications in 6.1.1. Transport collected samples to the laboratory taking care to minimize contamination and loss of sample (16).

[7.1 corrected by 44 FR 37915, June 29, 1979]

7.2 Sample preparation.

7.2.1 Hot extraction procedure.

7.2.1.1 Cut a 3/4" x 8" strip from the exposed filter using a template and a pizza cutter as described in Figures 1 and 2. Other cutting procedures may be used.

Lead in ambient particulate matter collected on glass fiber filters has been shown to be uniformly distributed across the filter.[1,3,11] Another study[12] has shown that when sampling near a roadway, strip position contributes significantly to the overall variability associated with lead analyses. Therefore, when sampling near a roadway, additional strips should be analyzed to minimize this variability.

[7.2.1.1 corrected by 44 FR 37915, June 29, 1979]

7.2.1.2 Fold the strip in half twice and place in a 150-ml beaker. Add 15 ml of 3 *M* HNO_3 to cover the sample. The acid should completely cover the sample. Cover the beaker with a watch glass.

7.2.1.3 Place beaker on the hot-plate, contained in a fume hood, and boil gently for 30 min. Do not let the sample evaporate to dryness. *Caution:* Nitric acid fumes are toxic.

7.2.1.4 Remove beaker from hot plate and cool to near room temperature.

7.2.1.5 Quantitatively transfer the sample as follows:

7.2.1.5.1 Rinse watch glass and sides of beaker with D.I. water.

7.2.1.5.2 Decant extract and rinsings into a 100-ml volumetric flask.

7.2.1.5.3 Add D.I. water to 40 ml mark on beaker, cover with watch glass, and set aside for a minimum of 30 minutes. This is a critical step and cannot be omitted since it allows the HNO_3 trapped in the filter to diffuse into the rinse water.

7.2.1.5.4 Decant the water from the filter into the volumetric flask.

7.2.1.5.5 Rinse filter and beaker twice with D.I. water and add rinsings to volumetric flask until total volume is 80 to 85 ml.

7.2.1.5.6 Stopper flask and shake vigorously. Set aside for approximately 5 minutes or until foam has dissipated.

7.2.1.5.7 Bring solution to volume with D.I. water. Mix thoroughly.

7.2.1.5.8 Allow solution to settle for one hour before proceeding with analysis.

7.2.1.5.9 If sample is to be stored for subsequent analysis, transfer to a linear polyethylene bottle.

7.2.2 Ultrasonic extraction procedure.

7.2.2.1 Cut a ¾" x 8" strip from the exposed filter as described in section 7.2.1.1.

7.2.2.2 Fold the strip in half twice and place in a 30 ml beaker. Add 15 ml of the HNO_3/HCl solution in 6.2.6. The acid should completely cover the sample. Cover the beaker with parafilm.

The parafilm should be placed over the beaker such that none of the parafilm is in contact with water in the ultrasonic bath. Otherwise, rinsing of the parafilm (section 7.2.2.4.1) may contaminate the sample.

7.2.2.3 Place the beaker in the ultrasonication bath and operate for 30 minutes.

7.2.2.4 Quantitatively transfer the sample as follows:

7.2.2.4.1 Rinse parafilm and sides of beaker with D.I. water.

7.2.2.4.2 Decant extract and rinsings into a 100 ml volumetric flask.

7.2.2.4.3 Add 20 ml D.I. water to cover the filter strip, cover with parafilm, and set aside for a minimum of 30 minutes. This is a critical step and cannot be omitted. The sample is then processed as in sections 7.2.1.5.4 through 7.2.1.5.9.

NOTE.—Samples prepared by the hot extraction procedure are now in 0.45 *M* HNO_3. Samples prepared by the ultrasonication procedure are in 0.40 *M* HNO_3 + X *M* HCl.

8. *Analysis.*

8.1 Set the wavelength of the monochromator at 283.3 or 217.0 nm. Set or align other instrumental operating conditions as recommended by the manufacturer.

8.2 The sample can be analyzed directly from the volumetric flask, or an appropriate amount of sample decanted into a sample analysis tube. In either case, care should be taken not to disturb the settled solids.

8.3 Aspirate samples, calibration standards and blanks (section 9.2) into the flame and record the equilibrium absorbance.

8.4 Determine the lead concentration in μg Pb/ml, from the calibration curve, section 9.3.

8.5 Samples that exceed the linear calibration range should be diluted with acid of the same concentration as the calibration standards and reanalyzed.

9. *Calibration.*

9.1 Working standard, 20 μg Pb/ml. Prepared by diluting 2.0 ml of the master standard (6.3.1 if the hot acid extraction was used or 6.3.2 if the ultrasonic extraction procedure was used) to 100 ml with acid of the same concentration as used in preparing the master standard.

9.2 Calibration standards. Prepare daily by diluting the working standard, with the same acid matrix, as indicated below. Other lead concentrations may be used.

Volume of 20 μg/ml working standard, ml	Final volume, ml	Concentration μg Pb/ml
0	100	0
1.0	200	0.1
2.0	200	0.2
2.0	100	0.4
4.0	100	0.8
8.0	100	1.6
15.0	100	3.0
30.0	100	6.0
50.0	100	10.0
100.0	100	20.0

9.3 Preparation of calibration curve. Since the working range of analysis will vary depending on which lead line is used and the type of instrument, no one set of instructions for preparation of a calibration curve can be given. Select standards (plus the reagent blank), in the same acid concentration as the samples, to cover the linear absorption range indicated by the instrument manufacturer. Measure the absorbance of the blank and standards as in section 8.0. Repeat until good agreement is obtained between replicates. Plot absorbance (y-axis) versus concentration in μg Pb/ml (x-axis). Draw (or compute) a straight line through the linear portion of the curve. Do not force the calibration curve through zero. Other calibration procedures may be used.

To determine stability of the calibration curve, remeasure—alternately—one of the following calibration standards for every 10th sample analyzed: concentration ≤ 1μg Pb/ml; concentration ≤ 10 μg Pb/ml. If either standard deviates by more than 5 percent from the value predicted by the calibration curve, recalibrate and repeat the previous 10 analyses.

10. *Calculation.*

10.1 Measured air volume. Calculate the measured air volume at Standard Temperature and Pressure as described in Reference 10.

[10.1 corrected by 44 FR 37915, June 29, 1979]

10.2 Lead concentration. Calculate lead concentration in the air sample.

$$C = \frac{(\mu g\ Pb/ml \times 100\ ml/strip \times 12\ strips/filter) - F_b}{V_{STP}}$$

[Appendix G]

C2-B-15

where:

C = Concentration, μg Pb/sm^3.

μg Pb/ml = Lead concentration determined from section 8.

ml/strip = Total sample volume.

strips = Total usable filter area 8" x 9"

filter = Total area of one strip 3/4 x 8"

F_b = Lead concentration of blank filter, μg, from section 6.1.1.2.3.

V_{STP} = Air volume from 10.2.

[10.2 corrected by 44 FR 37915, June 29, 1979]

11. *Quality control.*

¾" x 8" glass fiber filter strips containing 80 to 2000 μg Pb/strip (as lead salts) and blank strips with zero Pb content should be used to determine if the method—as being used—has any bias. Quality control charts should be established to monitor differences between measured and true values. The frequency of such checks will depend on the local quality control program.

To minimize the possibility of generating unreliable data, the user should follow practices established for assuring the quality of air pollution data, (13) and take part in EPA's semiannual audit program for lead analyses.

12. *Trouble shooting.*

1. During extraction of lead by the hot extraction procedure, it is important to keep the sample covered so that corrosion products—formed on fume hood surfaces which may contain lead—are not deposited in the extract.

2. The sample acid concentration should minimize corrosion of the nebulizer. However, different nebulizers may require lower acid concentrations. Lower concentrations can be used provided samples and standards [have] the same acid concentration.

[3. A]shing of particulate samples has been [fou]nd, by EPA and contractor laboratories, to be unnecessary in lead analyses by atomic absorption. Therefore, this step was omitted from the method.

4. Filtration of extracted samples, to remove particulate matter, was specifically excluded from sample preparation, because some analysts have observed losses of lead due to filtration.

5. If suspended solids should clog the nebulizer during analysis of samples, centrifuge the sample to remove the solids.

13. *Authority.*

(Secs. 109 and 301(a), Clean Air Act as amended, (42 U.S.C. 7409, 7601(a)).)

14. *References.*

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13. *Quality Assurance Handbook for Air Pollution Measurement System. Volume I—Principles.* EPA-600/9-76-005, March 1976.

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15. To be published. EPA, QAB, EMSL, RTP, N.C. 27711

16. *Quality Assurance Handbook for Air Pollution Measurement Systems. Volume II—Ambient Air Specific Methods.* EPA-600/4-77/027a, May 1977.

[Corrected by 44 FR 37915, June 29, 1979] diameter less than or equal to a nominal 10 micrometers) by:

(1) A reference method based on Appendix J and designated in accordance with Part 53 of this chapter, or

(2) An equivalent method designated in accordance with Part 53 of this chapter.

§50.7 [Removed and reserved]

3. Section 50.7 is removed and reserved.

4. In Appendix G, reference 10 is removed and reserved and section 5.1.1 is revised to read as follows:

5.1.1 *High-Volume Sampler.* Use and calibrate the sampler as described in Appendix B to this Part.

5. Appendix I is added and reserved.

Appendix I [Reserved]

6. Appendix J is added to read as follows:

Appendix J—Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere

1.0 *Applicability.*

1.1 This method provides for the measurement of the mass concentration of particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}) in ambient air over a 24-hour period for purposes of determining attainment and maintenance of the primary and secondary national ambient air quality standards for particulate matter specified in § 50.6 of this chapter. The measurement process is nondestructive, and the PM_{10} sample can be subjected to subsequent physical or chemical analyses. Quality assurance procedures and guidance are provided in Part 58, Appendices A and B, of this chapter and in References 1 and 2.

2.0 *Principle.*

2.1 An air sampler draws ambient air at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within the PM_{10} size range. Each size fraction in the PM_{10} size range is then collected on a separate filter over the specified sampling period. The particle size discrimination characteristics (sampling effectiveness and 50 percent cutpoint) of the sampler inlet are prescribed as performance specifications in Part 53 of this chapter.

2.2 Each filter is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain due to collected PM_{10}. The total volume of air sampled, corrected to EPA reference conditions (25° C, 101.3 kPa), is determined from the measured flow rate and the sampling time. The mass concentration of PM_{10} in the ambient air is computed as the total mass of collected particles in the PM_{10} size range divided by the volume of air sampled, and is expressed in micrograms per standard cubic meter ($\mu g/std\ m^3$). For PM_{10} samples collected at temperatures and pressures significantly different from EPA reference conditions, these corrected concentrations sometimes differ substantially from actual concentrations (in micrograms per actual cubic meter), particularly at high elevations. Although not required, the actual PM_{10} concentration can be calculated from the corrected concentration, using the average ambient temperature and barometric pressure during the sampling period.

2.3 A method based on this principle will be considered a reference method only if (a) the associated sampler meets the requirements specified in this appendix and the requirements in Part 53 of this chapter, and (b) the method has been designated as a reference method in accordance with Part 53 of this chapter.

3.0 *Range.*

3.1 The lower limit of the mass concentration range is determined by the repeatability of filter tare weights, assuming the nominal air sample volume for the sampler. For samplers having an automatic filter-changing mechanism, there may be no upper limit. For samplers that do not have an automatic filter-changing mechanism, the upper limit is determined by the filter mass loading beyond which the sampler no longer maintains the operating flow rate within specified limits due to increased pressure drop across the loaded filter. This upper limit cannot be specified precisely because it is a complex function of the ambient particle size distribution and type, humidity, filter type, and perhaps other factors. Nevertheless, all samplers should be capable of measuring 24-hour PM_{10} mass concentrations of at least 300 $\mu g/std\ m^3$ while maintaining the operating flow rate within the specified limits.

4.0 *Precision.*

4.1 The precision of PM_{10} samplers must be 5 $\mu g/m^3$ for PM_{10} concentrations below 80 $\mu g/m^3$ and 7 percent for PM_{10} concentrations above 80 $\mu g/m^3$, as required by Part 53 of this chapter, which prescribes a test procedure that determines the variation in the PM_{10} concentration measurements of identical samplers under typical sampling conditions. Continual assessment of precision via collocated samplers is required by Part 58 of this chapter for PM_{10} samplers used in certain monitoring networks.

5.0 *Accuracy.*

5.1 Because the size of the particles making up ambient particulate matter varies over a wide range and the concentration of particles varies with particle size, it is difficult to define the absolute accuracy of PM_{10} samplers. Part 53 of this chapter provides a specification for the sampling effectiveness of PM_{10} samplers. This specification requires that the expected mass concentration calculated for a candidate PM_{10} sampler, when sampling a specified particle size distribution, be within ±10 percent of that calculated for an ideal sampler whose sampling effectiveness is explicitly specified. Also, the particle size for 50 percent sampling effectiveness is required to be 10±0.5 micrometers. Other specifications related to accuracy apply to flow measurement and calibration, filter media, analytical (weighing) procedures, and artifact. The flow rate accuracy of PM_{10} samplers used in certain monitoring networks is required by Part 58 of this chapter to be assessed periodically via flow rate audits.

6.0 *Potential Sources of Error.*

6.1 *Volatile Particles.* Volatile particles collected on filters are often lost during shipment and/or storage of the filters prior to the post-sampling weighing [3]. Although shipment or storage of loaded filters is sometimes unavoidable, filters should be reweighed as soon as practical to minimize these losses.

6.2 *Artifacts.* Positive errors in PM_{10} concentration measurements may result from retention of gaseous species on filters [4,5]. Such errors include the retention of sulfur dioxide and nitric acid. Retention of sulfur dioxide on filters, followed by oxidation to sulfate, is referred to as artifact sulfate formation, a phenomenon which increases with increasing filter alkalinity [6]. Little or no artifact sulfate formation should occur using filters that meet the alkalinity specification in section 7.2.4. Artifact nitrate formation, resulting primarily from retention of nitric acid, occurs to varying degrees on many filter types, including glass fiber, cellulose ester, and many quartz fiber filters [5,7,8,9,10]. Loss of true atmospheric particulate nitrate during or following sampling may also occur due to dissociation or chemical reaction. This phenomenon has been observed on Teflon® filters [8] and inferred for quartz fiber filters [11,12]. The magnitude of nitrate artifact errors in PM_{10} mass concentration measurements will vary with location and ambient temperature; however, for most sampling locations, these errors are expected to be small.

6.3 *Humidity.* The effects of ambient humidity on the sample are unavoidable. The filter equilibration procedure in section 9.0 is designed to minimize the effects of moisture on the filter medium.

6.4 *Filter Handling.* Careful handling of filters between presampling and postsampling weighings is necessary to avoid errors due to damaged filters or loss of collected particles from the filters. Use of a filter cartridge or cassette may reduce the magnitude of these errors. Filters must also meet the integrity specification in section 7.2.3.

6.5 *Flow Rate Variation.* Variations in the sampler's operating flow rate may alter the particle size discrimination characteristics of the sampler inlet. The magnitude of this error will depend on the sensitivity of the inlet to variations in flow rate and on the particle distribution in the atmosphere during the sampling period. The use of a flow control device (section 7.1.3) is required to minimize this error.

6.6 *Air Volume Determination.* Errors in the air volume determination may result from errors in the flow rate and/or sampling time measurements. The flow control device serves to minimize errors in the flow rate determination, and an elapsed time meter (section 7.1.5) is required to minimize the error in the sampling time measurement.

7.0 *Apparatus.*

7.1 *PM_{10} Sampler.*

7.1.1 The sampler shall be designed to:

a. Draw the air sample into the sampler inlet and through the particle collection filter at a uniform face velocity.

b. Hold and seal the filter in a horizontal position so that sample air is drawn downward through the filter.

c. Allow the filter to be installed and removed conveniently.

d. Protect the filter and sampler from precipitation and prevent insects and other debris from being sampled.

e. Minimize air leaks that would cause error in the measurement of the air volume passing through the filter.

f. Discharge exhaust air at a sufficient distance from the sampler inlet to minimize the sampling of exhaust air.

g. Minimize the collection of dust from the supporting surface.

7.1.2 The sampler shall have a sample air inlet system that, when operated within a specified flow rate range, provides particle size discrimination characteristics meeting all of the applicable performance specifications prescribed in Part 53 of this chapter. The sampler inlet shall show no significant wind direction dependence. The latter requirement can generally be satisfied by an inlet shape that is circularly symmetrical about a vertical axis.

7.1.3 The sampler shall have a flow control device capable of maintaining the sampler's operating flow rate within the flow rate limits specified for the sampler inlet over normal variations in line voltage and filter pressure drop.

7.1.4 The sampler shall provide a means to measure the total flow rate during the sampling period. A continuous flow recorder is recommended but not required. The flow measurement device shall be accurate to ±2 percent.

7.1.5 A timing/control device capable of starting and stopping the sampler shall be used to obtain a sample collection period of 24 ±1 hr (1,440 ±60 min). An elapsed time meter, accurate to within ±15 minutes, shall be used to measure sampling time. This meter is optional for samplers with continuous flow recorders if the sampling time measurement obtained by means of the recorder meets the ±15 minute accuracy specification.

7.1.6 The sampler shall have an associated operation or instruction manual as required by Part 53 of this chapter which includes detailed instructions on the calibration, operation, and maintenance of the sampler.

7.2 *Filters.*

7.2.1 *Filter Medium.* No commercially available filter medium is ideal in all respects for all samplers. The user's goals in sampling determine the relative importance of various filter characteristics (e.g., cost, ease of handling, physical and chemical characteristics, etc.) and, consequently, determine the choice among acceptable filters. Furthermore, certain types of filters may not be suitable for use with some samplers, particularly under heavy loading conditions (high mass concentrations), because of high or rapid increase in the filter flow resistance that would exceed the capability of the sampler's flow control device. However, samplers equipped with automatic filter-changing mechanisms may allow use of these types of filters. The specifications given below are minimum requirements to ensure acceptability of the filter medium for measurement of PM_{10} mass concentrations. Other filter evaluation criteria should be considered to meet individual sampling and analysis objectives.

7.2.2 *Collection Efficiency.* >99 percent, as measured by the DOP test (ASTM-2986) with 0.3 μm particles at the sampler's operating face velocity.

7.2.3 *Integrity.* ±5 μg/m³ (assuming sampler's nominal 24-hour air sample volume). Integrity is measured as the PM_{10} concentration equivalent corresponding to the average difference between the initial and the final weights of a random sample of test filters that are weighed and handled under actual or simulated sampling conditions, but have no air sample passed through them (i.e., filter blanks). As a minimum, the test procedure must include initial equilibration and weighing, installation on an inoperative sampler, removal from the sampler, and final equilibration and weighing.

7.2.4 *Alkalinity.* <25 microequivalents/gram of filter, as measured by the procedure given in Reference 13 following at least two months storage in a clean environment (free from contamination by acidic gases) at room temperature and humidity.

7.3 *Flow Rate Transfer Standard.* The flow rate transfer standard must be suitable for the sampler's operating flow rate and must be calibrated against a primary flow or volume standard that is traceable to the National Bureau of Standards (NBS). The flow rate transfer standard must be capable of measuring the sampler's operating flow rate with an accuracy of ±2 percent.

7.4 *Filter Conditioning Environment.*

7.4.1 Temperature range: 15° to 30° C.

7.4.2 Temperature control: ±3° C.

7.4.3 Humidity range: 20% to 45% RH.

7.4.4 Humidity control: ±5% RH.

7.5 *Analytical Balance.* The analytical balance must be suitable for weighing the type and size of filters required by the sampler. The range and sensitivity required will depend on the filter tare weights and mass loadings. Typically, an analytical balance with a sensitivity of 0.1 mg is required for high volume samplers (flow rates >0.5 m³/min). Lower volume samplers (flow rates <0.5 m³/min) will require a more sensitive balance.

8.0 *Calibration.*

8.1 *General Requirements.*

8.1.1 Calibration of the sampler's flow measurement device is required to establish traceability of subsequent flow measurements to a primary standard. A flow rate transfer standard calibrated against a primary flow or volume standard shall be used to calibrate or verify the accuracy of the sampler's flow measurement device.

8.1.2 Particle size discrimination by inertial separation requires that specific air velocities be maintained in the sampler's air inlet system. Therefore, the flow rate through the sampler's inlet must be maintained throughout the sampling period within the design flow rate range specified by the manufacturer. Design flow rates are specified as actual volumetric flow rates, measured at existing conditions of temperature and pressure (Q_a). In contrast, mass concentrations of PM_{10} are computed using flow rates corrected to EPA reference conditions of temperature and pressure (Q_{std}).

8.2 *Flow Rate Calibration Procedure.*

8.2.1 PM_{10} samplers employ various types of flow control and flow measurement devices. The specific procedure used for flow rate calibration or verification will vary depending on the type of flow controller and flow indicator employed. Calibration in terms of actual volumetric flow rates (Q_a) is generally recommended, but other measures of flow rate (e.g., Q_{std}) may be used provided the requirements of section 8.1 are met. The general procedure given here is based on actual volumetric flow units (Q_a) and serves to illustrate the steps involved in the calibration of a PM_{10} sampler. Consult the sampler manufacturer's instruction manual and Reference 2 for specific guidance on calibration. Reference 14 provides additional information on the use of the commonly used measures of flow rate and their interrelationships.

8.2.2 Calibrate the flow rate transfer standard against a primary flow or volume standard traceable to NBS. Establish a calibration relationship (e.g., an equation or family of curves) such that traceability to the primary standard is accurate to within 2 percent over the expected range of ambient conditions (i.e., temperatures and pressures) under which the transfer standard will be used. Recalibrate the transfer standard periodically.

8.2.3 Following the sampler manufacturer's instruction manual, remove the sampler inlet and connect the flow rate transfer standard to the sampler such that the transfer standard accurately measures the sampler's flow rate. Make sure there are no leaks between the transfer standard and the sampler.

8.2.4 Choose a minimum of three flow rates (actual m³/min), spaced over the acceptable flow rate range specified for the inlet (see 7.1.2) that can be obtained by suitable adjustment of the sampler flow rate. In accordance with the sampler manufacturer's instruction manual, obtain or verify the calibration relationship between the flow rate (actual m³/min) as indicated by the transfer standard and the sampler's flow indicator response. Record the ambient temperature and barometric pressure. Temperature and pressure corrections to subsequent flow indicator readings may be required for certain types of flow measurement devices. When such corrections are necessary, correction on an individual or daily basis is preferable. However, seasonal average temperature and average barometric pressure for the sampling site may be incorporated into the sampler calibration to avoid daily corrections. Consult the sampler manufacturer's instruction manual and Reference 2 for additional guidance.

8.2.5 Following calibration, verify that the sampler is operating at its design flow rate (actual m³/min) with a clean filter in place.

8.2.6 Replace the sampler inlet.

9.0 *Procedure.*

9.1 The sampler shall be operated in accordance with the specific guidance provided in the sampler manufacturer's instruction manual and in Reference 2. The general procedure given here assumes that the sampler's flow rate calibration is based on flow rates at ambient conditions (Q_a) and serves to illustrate the steps involved in the operation of a PM_{10} sampler.

9.2 Inspect each filter for pinholes, particles, and other imperfections. Establish a filter information record and assign an identification number to each filter.

9.3 Equilibrate each filter in the conditioning environment (see 7.4) for at least 24 hours.

9.4 Following equilibration, weigh each filter and record the presampling weight with the filter identification number.

9.5 Install a preweighed filter in the sampler following the instructions provided in the sampler manufacturer's instructional manual.

9.6 Turn on the sampler and allow it to establish run-temperature conditions. Record the flow indicator reading and, if needed, the ambient temperature and barometric pressure. Determine the sampler flow rate (actual m^3/min) in accordance with the instructions provided in the sampler manufacturer's instruction manual. NOTE.—No onsite temperature or pressure measurements are necessary if the sampler's flow indicator does not require temperature or pressure corrections or if seasonal average temperature and average barometric pressure for the sampling site are incorporated into the sampler calibration (see step 8.2.4). If individual or daily temperature and pressure corrections are required, ambient temperature and barometric pressure can be obtained by on-site measurements or from a nearby weather station. Barometric pressure readings obtained from airports must be station pressure, not corrected to sea level, and may need to be corrected for differences in elevation between the sampling site and the airport.

9.7 If the flow rate is outside the acceptable range specified by the manufacturer, check for leaks, and if necessary, adjust the flow rate to the specified setpoint. Stop the sampler.

9.8 Set the timer to start and stop the sampler at appropriate times. Set the elapsed time meter to zero or record the initial meter reading.

9.9 Record the sample information (site location or identification number, sample date, filter identification number, and sampler model and serial number).

9.10 Sample for 24±1 hours.

9.11 Determine and record the average flow rate (Q_a) in actual m^3/min for the sampling period in accordance with the instructions provided in the sampler manufacturer's instruction manual. Record the elapsed time meter final reading and, if needed, the average ambient temperature and barometric pressure for the sampling period (see note following step 9.6).

9.12 Carefully remove the filter from the sampler, following the sampler manufacturer's instruction manual. Touch only the outer edges of the filter.

9.13 Place the filter in a protective holder or container (e.g., petri dish, glassine envelope, or manila folder).

9.14 Record any factors such as meteorological conditions, construction activity, fires or dust storms, etc., that might be pertinent to the measurement on the filter information record.

9.15 Transport the exposed sample filter to the filter conditioning environment as soon as possible for equilibration and subsequent weighing.

9.16 Equilibrate the exposed filter in the conditioning environment for at least 24 hours under the same temperature and humidity conditions used for presampling filter equilibration (see 9.3).

9.17 Immediately after equilibration, reweigh the filter and record the postsampling weight with the filter identification number.

10.0 *Sampler Maintenance.*

10.1 The PM_{10} sampler shall be maintained in strict accordance with the maintenance procedures specified in the sampler manufacturer's instruction manual.

11.0 *Calculations.*

11.1 Calculate the average flow rate over the sampling period corrected to EPA reference conditions as Q_{std}. When the sampler's flow indicator is calibrated in actual volumetric units (Q_a), Q_{std} is calculated as:

$$Q_{std}=Q_a\times(P_{av}/T_{av})(T_{std}/P_{std})$$

where

Q_{std} = average flow rate at EPA reference conditions, std m^3/min;
Q_a = average flow rate at ambient conditions, m^3/min;
P_{av} = average barometric pressure during the sampling period or average barometric pressure for the sampling site, kPa (or mm Hg);
T_{av} = average ambient temperature during the sampling period or seasonal average ambient temperature for the sampling site, K;
T_{std} = standard temperature, defined as 298 K;
P_{std} = standard pressure, defined as 101.3 kPa (or 760 mm Hg).

11.2 Calculate the total volume of air sampled as:

$$V_{std}=Q_{std}\times t$$

where

V_{std} = total air sampled in standard volume units, std m^3;
t = sampling time, min.

11.3 Calculate the PM_{10} concentration as:

$$PM_{10}=(W_f-W_i)\times10^6/V_{std}$$

where

PM_{10} = mass concentration of PM_{10}, μg/std m^3;
W_f, W_i = final and initial weights of filter collecting PM_{10} particles, g;
10^6 = conversion of g to μg.

Note.—If more than one size fraction in the PM_{10} size range is collected by the sampler, the sum of the net weight gain by each collection filter $[\Sigma(W_f-W_i)]$ is used to calculate the PM_{10} mass concentration.

12.0 *References.*

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7. Appendix K is added to read as follows:

Appendix K—Interpretation of the National Ambient Air Quality Standards for Particulate Matter

1.0 *General.*

This appendix explains the computations necessary for analyzing particulate matter data to determine attainment of the 24-hour and annual standards specified in 40 CFR 50.6. For the primary and secondary standards, particulate matter is measured in the ambient air as PM_{10} (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers) by a reference method based on Appendix J of this part and designated in accordance with Part 53 of this chapter, or by an equivalent method designated in accordance with Part 53 of this chapter. The required frequency of measurements is specified in Part 58 of this chapter.

Several terms used throughout this appendix must be defined. A "daily value" for PM_{10} refers to the 24-hour average concentration of PM_{10} calculated or measured from midnight to midnight (local time). The term "exceedance" means a daily value that is above the level of the 24-hour standard after rounding to the nearest 10 $\mu g/m^3$ (i.e., values ending in 5 or greater are to be rounded up). The term "average" refers to an arithmetic mean. All particulate matter standards are expressed in terms of expected annual values: expected number of exceedances per year for the 24-hour standard and expected annual arithmetic mean for the annual standards. The "expected annual value" is the number approached when the annual values from an increasing number of years are averaged, in the absence of long-term trends in emissions or meteorological conditions. The term "year" refers to a calendar year.

Although the discussion in this appendix focuses on monitored data, the same principles apply to modeling data, subject to EPA modeling guidelines.

2.0 *Attainment Determinations.*

2.1 *24-Hour Primary and Secondary Standards.*

Under 40 CFR 50.6(a) the 24-hour primary and secondary standards are attained when the expected number of exceedances per year at each monitoring site is less than or equal to one. In the simplest case, the number of expected exceedances at a site is determined by recording the number of exceedances in each calendar year and then averaging them over the past 3 calendar years. Situations in which 3 years of data are not available and possible adjustments for unusual events or trends are discussed in Sections 2.3 and 2.4. Further, when data for a year are incomplete, it is necessary to compute an estimated number of exceedances for that year by adjusting the observed number of exceedances. This procedure, performed by calendar quarter, is described in Section 3. The expected number of exceedances is then estimated by averaging the individual annual estimates for the past 3 years.

The comparison with the allowable expected exceedance rate of one per year is made in terms of a number rounded to the nearest tenth (fractional values equal to or greater than 0.05 are to be rounded up; e.g., an exceedance rate of 1.05 would be rounded to 1.1, which is the lowest rate for nonattainment).

2.2 *Annual Primary and Secondary Standards.*

Under 40 CFR 50.6(b), the annual primary and secondary standards are attained when the expected annual arithmetic mean PM_{10} concentration is less than or equal to the level of the standard. In the simplest case, the expected annual arithmetic mean is determined by averaging the annual arithmetic mean PM_{10} concentrations for the past 3 calendar years. Because of the potential for incomplete data and the possible seasonality in PM_{10} concentrations, the annual mean shall be calculated by averaging the four quarterly means of PM_{10} concentrations within the calendar year. The formulas for calculating the annual arithmetic mean are given in Section 4. Situations in which 3 years of data are not available and possible adjustments for unusual events or trends are discussed in Sections 2.3 and 2.4. The expected annual arithmetic mean is rounded to the nearest 1 $\mu g/m^3$ before comparison with the annual primary standard (fractional values equal to or greater than 0.5 are to be rounded up).

2.3 *Data Requirements.*

40 CFR 58.13 specifies the required minimum frequency of sampling for PM_{10}. For the purposes of making comparisons with the particulate matter standards, all data produced by National Air Monitoring Stations (NAMS), State and Local Air Monitoring Stations (SLAMS) and other sites submitted to EPA in accordance with the Part 58 requirements must be used, and a minimum of 75 percent of the scheduled PM_{10} samples per quarter are required.

To demonstrate attainment of either the annual or 24-hour standards at a monitoring site, the monitor must provide sufficient data to perform the required calculations of Sections 3 and 4. The amount of data required varies with the sampling frequency, data capture rate and the number of years of record. In all cases, 3 years of representative monitoring data that meet the 75 percent criterion of the previous paragraph should be utilized, if available, and would suffice. More than 3 years may be considered, if all additional representative years of data meeting the 75 percent criterion are utilized. Data not meeting these criteria may also suffice to show attainment; however, such exceptions will have to be approved by the appropriate Regional Administrator in accordance with EPA guidance.

There are less stringent data requirements for showing that a monitor has failed an attainment test and thus has recorded a violation of the particulate matter standards. Although it is generally necessary to meet the minimum 75 percent data capture requirement per quarter to use the computational formulas described in Sections 3 and 4, this criterion does not apply when less data is sufficient to unambiguously establish nonattainment. The following examples illustrate how nonattainment can be demonstrated when a site fails to meet the completeness criteria. Nonattainment of the 24-hour primary standards can be established by (a) the observed annual number of exceedances (e.g. four observed exceedances in a single year), or by (b) the estimated number of exceedances derived from the observed number of exceedances and the required number of scheduled samples (e.g. two observed exceedances with every other day sampling). Nonattainment of the annual standards can be demonstrated on the basis of quarterly mean concentrations developed from observed data combined with one-half the minimum detectable concentration substituted for missing values. In both cases, expected annual values must exceed the levels allowed by the standards.

2.4 *Adjustment for Exceptional Events and Trends.*

An exceptional event is an uncontrollable event caused by natural sources of particulate matter or an event that is not expected to recur at a given location. Inclusion of such a value in the computation of exceedances or averages could result in inappropriate estimates of their respective expected annual values. To reduce the effect of unusual events, more than 3 years of representative data may be used. Alternatively, other techniques, such as the use of statistical models or the use of historical data could be considered so that the event may be discounted or weighted according to the likelihood that it will recur. The use of such techniques is subject to the approval of the appropriate Regional Administrator in accordance with EPA guidance.

In cases where long-term trends in emissions and air quality are evident, mathematical techniques should be applied to account for the trends to ensure that the expected annual values are not inappropriately biased by unrepresentative data. In the simplest case, if 3 years of data are available under stable emission conditions, this data should be used. In the event of a trend or shift in emission patterns, either the most recent representative year(s) could be used or statistical techniques or models could be used in conjunction with previous years of data to adjust for trends. The use of less than 3 years of data, and any adjustments are subject to the approval of the appropriate Regional Administrator in accordance with EPA guidance.

3.0 *Computational formulas for the 24-hour standard.*

3.1 *Estimating Exceedances for a year.*

If PM_{10} sampling is scheduled less frequently than every day, or if some scheduled samples are missed, a PM_{10} value will not be available for each day of the year. To account for the possible effect of incomplete data, an adjustment must be made to the data collected at each monitoring location to estimate the number of exceedances in a calendar year. In this adjustment, the assumption is made that the fraction of missing values that would have exceeded the standard level is identical to the fraction of measured values above this level. This computation is to be made for all sites that are scheduled to monitor throughout the entire year and meet the minimum data requirements of Section 2.3. Because of possible seasonal imbalance, this adjustment shall be applied on a quarterly basis. The estimate of the expected number of exceedances for the quarter is equal to the observed number of exceedances plus an increment associated with the missing data. The following formula must be used for these computations:

$$e_q = v_q + [(v_q/n_q) \times (N_q - n_q)] = v_q \times N_q/n_q \qquad [1]$$

where

e_q = the estimated number of exceedances for calendar quarter q,
v_q = the observed number of exceedances for calendar quarter q,
N_q = the number of days in calendar quarter q,
n_q = the number of days in calendar quarter q with PM_{10}, and
q = the index for calendar quarter, q = 1, 2, 3 or 4.

The estimated number of exceedances for a calendar quarter must be rounded to the nearest hundredth (fractional values equal to or greater than 0.005 must be rounded up).

The estimated number of exceedances for the years, e, is the sum of the estimates for each calendar quarter.

$$e = \sum_{q=1}^{4} e_q \qquad [2]$$

The estimated number of exceedances for a single year must be rounded to one decimal place (fractional values equal to or greater than 0.05 are to be rounded up). The expected number of exceedances is then estimated by averaging the individual annual estimates for the most recent 3 or more representative years of data. The expected number of exceedances must be rounded to one decimal place (fractional values equal to or greater than 0.05 are to be rounded up).

The adjustment for incomplete data will not be necessary for monitoring or modeling data which constitutes a complete record, i.e., 365 days per year.

To reduce the potential for overestimating the number of expected exceedances, the correction for missing data will not be required for a calendar quarter in which the first observed exceedance has occurred if: (a) there was only one exceedance in the calendar quarter, (b) everyday sampling is subsequently initiated and maintained for 4 calendar quarters in accordance with 40 CFR § 58.13 and (c) data capture of 75 percent is achieved during the required period of everyday sampling. In addition, if the first exceedance is observed in a calendar quarter in which the monitor is already sampling every day, no adjustment for missing data will be made to the first exceedance if a 75 percent data capture rate was achieved in the quarter in which it was observed.

Example 1

During a particular calendar quarter, 39 out of a possible 92 samples were recorded, with one observed exceedance of the 24-hour standard. Using formula [1], the estimated number of exceedances for the quarter is

$e_q = 1 \times 92/39 = 2.359$ or 2.36

If the estimated exceedances for the other 3 calendar quarters in the year were 2.30, 0.0 and 0.0, then, using formula [2], the estimated number of exceedances for the year is 2.36 + 2.30 + 0.0 + 0.0 which equals 4.66 or 4.7. If no exceedances were observed for the 2 previous years, then the expected number of exceedances is estimated by (1/3) × (4.7 + 0 + 0) = 1.57 or 1.6. Since 1.6 exceeds the allowable number of expected exceedances, this monitoring site would fail the attainment test.

Example 2

In this example, everyday sampling was initiated following the first observed exceedance as required by 40 CFR § 58.13. Accordingly, the first observed exceedance would not be adjusted for incomplete sampling. During the next three quarters, 1.2 exceedances were estimated. In this case, the estimated exceedances for the year would be 1.0 + 1.2 + 0.0 + 0.0 which equals 2.2. If, as before, no exceedances were observed for the two previous years, then the estimated exceedances for the 3-year period would then be (1/3) × (2.2 + 0.0 + 0.0) = 0.7, and the monitoring site would *not* fail the attainment test.

3.2 *Adjustments for Non-Scheduled Sampling Days.*

If a systematic sampling schedule is used and sampling is performed on days in addition to the days specified by the systematic sampling schedule, e.g., during episodes of high pollution, then an adjustment must be made in the formula for the estimation of exceedances. Such an adjustment is needed to eliminate the bias in the estimate of the quarterly and annual number of exceedances that would occur if the chance of an exceedance is different for scheduled than for non-scheduled days, as would be the case with episode sampling.

The required adjustment treats the systematic sampling schedule as a stratified sampling plan. If the period from one scheduled sample until the day preceding the next scheduled sample is defined as a sampling stratum, then there is one stratum for each scheduled sampling day. An average number of observed exceedances is computed for each of these sampling strata. With nonscheduled sampling days, the estimated number of exceedances is defined as

$$e_q = (N_q/m_q) \times \sum_{j=1}^{m_q} (v_j/k_j) \qquad [3]$$

where

e_q = the estimated number of exceedances for the quarter,
N_q = the number of days in the quarter,
m_q = the number of strata with samples during the quarter,
v_j = the number of observed exceedances in stratum j, and
k_j = the number of actual samples in stratum j.

Note that if only one sample value is recorded in each stratum, then formula [3] reduces to formula [1].

Example 3

A monitoring site samples according to a systematic sampling schedule of one sample every 6 days, for a total of 15 scheduled samples in a quarter out of a total of 92 possible samples. During one 6-day period, potential episode levels of PM_{10} were suspected, so 5 additional samples were taken. One of the regular scheduled samples was missed, so a total of 19 samples in 14 sampling strata were measured. The one 6-day sampling stratum with 6 samples recorded 2 exceedances. The remainder of the quarter with one sample per stratum recorded zero exceedances. Using formula [3], the estimated number of exceedances for the quarter is

$e_q = (92/14) \times (2/6 + 0 + \ldots + 0) = 2.19$

4.0 Computational Formulas for Annual Standards.

4.1 Calculation of the Annual Arithmetic Mean.

An annual arithmetic mean value for PM_{10} is determined by averaging the quarterly means for the 4 calendar quarters of the year. The following formula is to be used for calculation of the mean for a calendar quarter:

$$\bar{x}_q = (1/n_q) \times \sum_{i=1}^{n_q} x_i \qquad [4]$$

where

$\bar{x}_q$ = the quarterly mean concentration for quarter q, q = 1, 2, 3, or 4,
n_q = the number of samples in the quarter, and
x_i = the ith concentration value recorded in the quarter.

The quarterly mean, expressed in $\mu g/m^3$, must be rounded to the nearest tenth (fractional values of 0.05 should be rounded up).

The annual mean is calculated by using the following formula:

$$\bar{x} = (1/4) \times \sum_{q=1}^{4} \bar{x}_q \qquad [5]$$

where

$\bar{x}$ = the annual mean, and
$\bar{x}_q$ = the mean for calendar quarter q.

The average of quarterly means must be rounded to the nearest tenth (fractional values of 0.05 should be rounded up).

The use of quarterly averages to compute the annual average will not be necessary for monitoring or modeling data which results in a complete record, i.e., 365 days per year.

The expected annual mean is estimated as the average of three or more annual means. This multi-year estimate, expressed in $\mu g/m^3$, shall be rounded to the nearest integer for comparison with the annual standard (fractional values of 0.5 should be rounded up).

Example 4

Using formula (4), the quarterly means are calculated for each calendar quarter. If the quarterly means are 52.4, 75.3, 82.1, and 63.2 $\mu g/m^3$, then the annual means is

$$\bar{x} = (1/4) \times (52.4 + 75.3 + 82.1 + 63.2) = 68.25 \text{ or } 68.3$$

4.2 Adjustments for Non-scheduled Sampling Days.

An adjustment in the calculation of the annual mean is needed if sampling is performed on days in addition to the days specified by the systematic sampling schedule. For the same reasons given in the discussion of estimated exceedances (Section 3.2), the quarterly averages would be calculated by using the following formula:

$$\bar{x}_q = (1/m_q) \times \sum_{j=1}^{m_q} \sum_{i=1}^{k_j} (x_{ij}/k_j) \qquad [6]$$

where

$\bar{x}_q$ = the quarterly mean concentration for quarter q, q=1, 2, 3, or 4,

x_{ij} = the ith concentration value recorded in stratum j,

k_j = the number of actual samples in stratum j, and

m_q = the number of strata with data in the quarter.

If one sample value is recorded in each stratum, formula (6) reduces to a simple arithmetic average of the observed values as described by formula (4).

Example 5

During one calendar quarter, 9 observations were recorded. These samples were distributed among 7 sampling strata, with 3 observations in one stratum. The concentrations of the 3 observations in the single stratum were 202, 242, and 180 $\mu g/m^3$. The remaining 6 observed concentrations were 55, 68, 73, 92, 120, and 155 $\mu g/m^3$. Applying the weighting factors specified in formula (6), the quarterly mean is

$$\bar{x}_q = (1/7) \times [(1/3) \times (202 + 242 + 180) + 55 + 68 + 73 + 92 + 120 + 155] = 110.1$$

Although 24-hour measurements are rounded to the nearest 10 $\mu g/m^3$ for determinations of exceedances of the 24-hour standard, note that these values are rounded to the nearest 1 $\mu g/m^3$ for the calculation of means.

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ATTACHMENT C-3

QUALITY ASSURANCE PROJECT PLAN - 3

FOR

AIR SAMPLING OF ASBESTOS

QUALITY ASSURANCE PROJECT PLAN - 3

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QUALITY ASSURANCE PROJECT PLAN - 3

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP-3) presents the organization, objectives, functional activities, quality assurance and quality control activities associated with air sampling for asbestos at the Johns-Manville Disposal Area. Air sampling is a part of the Remedial Action being implemented at the Johns-Manville Disposal Area. Air sampling is planned before, during and after Remedial Construction.

The Quality Assurance Project Plan for airborne asbestos sampling after Remedial Construction is an abridged and modified version of the Sample Quality Assurance Project Plan used during the October 1984 asbestos air sampling during Remedial Investigation.

2.0 PROJECT DESCRIPTION

2.1 Background

The Johns-Manville Disposal Area is located in the City of Waukegan, Illinois. Since 1922, manufacturing wastes from the plant have been disposed of at the Disposal Area. Some of these wastes contained encapsulated asbestos, friable asbestos and trace amounts of lead, chromium and other contaminants. Presently, no asbestos is being used in manufacturing.

In 1982, this site was included in the National Priorities List. A Remedial Investigation and Feasibility Study were conducted by Manville Corporation. Pursuant to the Consent Decree signed by Manville on December 31, 1987, Manville Corporation will carry out a Remedial Action.

2.2 Objectives and Use of Data

The primary objectives of air sampling activities described in this QAPP are to detect asbestos in ambient air before and during the initial phases of Remedial Construction and after establishment of a soil and vegetative cover.

Different sampling activities at different times are proposed to achieve the objectives mentioned above, as follows:

2.2.1 Air Sampling for Asbestos Before Starting Remedial Construction:

Ambient air sampling for asbestos will be conducted before the start of Remedial Construction (i.e. before the start of grading activities) for a period of five days to estimate the existing on-site air quality. Five (5) samples (one on each day) will be selected for TEM asbestos analysis based on predominant wind direction.

The data obtained from this sampling event will indicate existing, on-site, airborne asbestos concentrations, if any.

2.2.2 Air Monitoring for Asbestos During the Initial Phases of Remedial Construction:

Initial phases of Remedial Construction work involve site clearing, grading and smoothing, and placing the first layer of a sand/soil cover on the Disposal Area. During these initial phases, perimeter air monitoring/sampling for asbestos will be conducted. This perimeter air sampling will involve 24-hour sampling on all working days.

A short duration, concurrent perimeter air sampling also will be conducted which will involve sampling for 4 -8 hours every work day.

Data obtained from short duration sample analyses (by PCM method) will indicate the air quality downwind of the construction activities and will be the basis for selection of perimeter air samples to be analyzed by TEM. The short duration sample location with the highest loading will determine which perimeter sample will be tested by TEM.

Data obtained from analysis of selected perimeter air samples (24-hour sample) by TEM will be evaluated within 24 hours of the receipt of the data (data turn around time for TEM is 7 to 10 days) and will be used to indicate any potential threat to the surrounding environment due to ongoing Remedial Construction. Also, this data will be utilized to determine the need for additional dust suppressing measures, if any, to be implemented during Remedial Construction. All such data will be available for inspection on site.

2.2.3 Air Monitoring for Asbestos after the Establishment of a Soil and Vegetative Cover:

Post-Remedial Construction airborne asbestos air sampling will be initiated after the establishment of a soil and vegetative cover. Establishment of a vegetative cover will be considered adequate after three mowings of the planted grass.

The data obtained from these monitoring events will be utilized to determine the ambient air quality around the Disposal Area, and the need for any contingency measures.

2.3 Sampling/Monitoring Schedule

As mentioned earlier, pre-remedial construction sampling will be conducted for a period of five days before the start of remedial construction. The perimeter air sampling during construction will be carried out during initial phases of construction (approximately the first six to eight months after the start of Remedial Construction) as defined earlier.

The Post-Remedial Action sampling for asbestos will be conducted after the establishment of a soil and vegetative cover and every five years thereafter for a period of 15 years (number of sampling events = 4). After the 15 years, U.S. EPA will evaluate the need for further monitoring.

The project schedule for Post-Remedial Action air monitoring for asbestos is presented in Figure 2 of the Work Plan. Provisions for personal-air-monitoring during Remedial Construction are presented in the Health and Safety Plan (Attachment G).

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

3.1 Organization

The project organization for air sampling/monitoring activities is presented in Figure C3-1.

3.2 Responsibilities

Overall project supervision and coordination will be the responsibility of the Manville Project Coordinator. He will be responsible for accomplishing the tasks as per the directives of the "Consent Decree", as well as interacting with and reporting to the U.S. EPA and Illinois EPA (IEPA).

All project functional responsibilities lie with Manville's Remedial Construction Manager (RCM). He will be responsible for overseeing project tasks and ensuring their accomplishment. He will also be responsible for reporting the project progress to the Manville Project Coordinator and interact with U.S. EPA and IEPA on an as needed basis.

Overall coordination of on-site sampling activities will be the responsibility of the Contractor/Consultant Site Manager (CSM). He will coordinate, direct and supervise subcontractors and sampling teams.

An independent Quality Assurance Monitor (QAM) will be responsible for reviewing project documents and reports with respect to their conformance to the quality assurance objectives.

A contractor/laboratory will be identified for field sampling and measurement and data assessment. Clayton Environmental Consultants and Environmental Monitoring Systems (EMS) will be utilized for asbestos analyses as discussed earlier in QAPP C-1. However, asbestos fiber counting of one sample from short duration perimeter air monitoring may be accomplished on site by using PCM - NIOSH 7400 method to obtain timely information needed to modify dust suppression activities. U.S. EPA/IEPA representatives will be notified in advance of all monitoring/sampling activities.

Project Organization

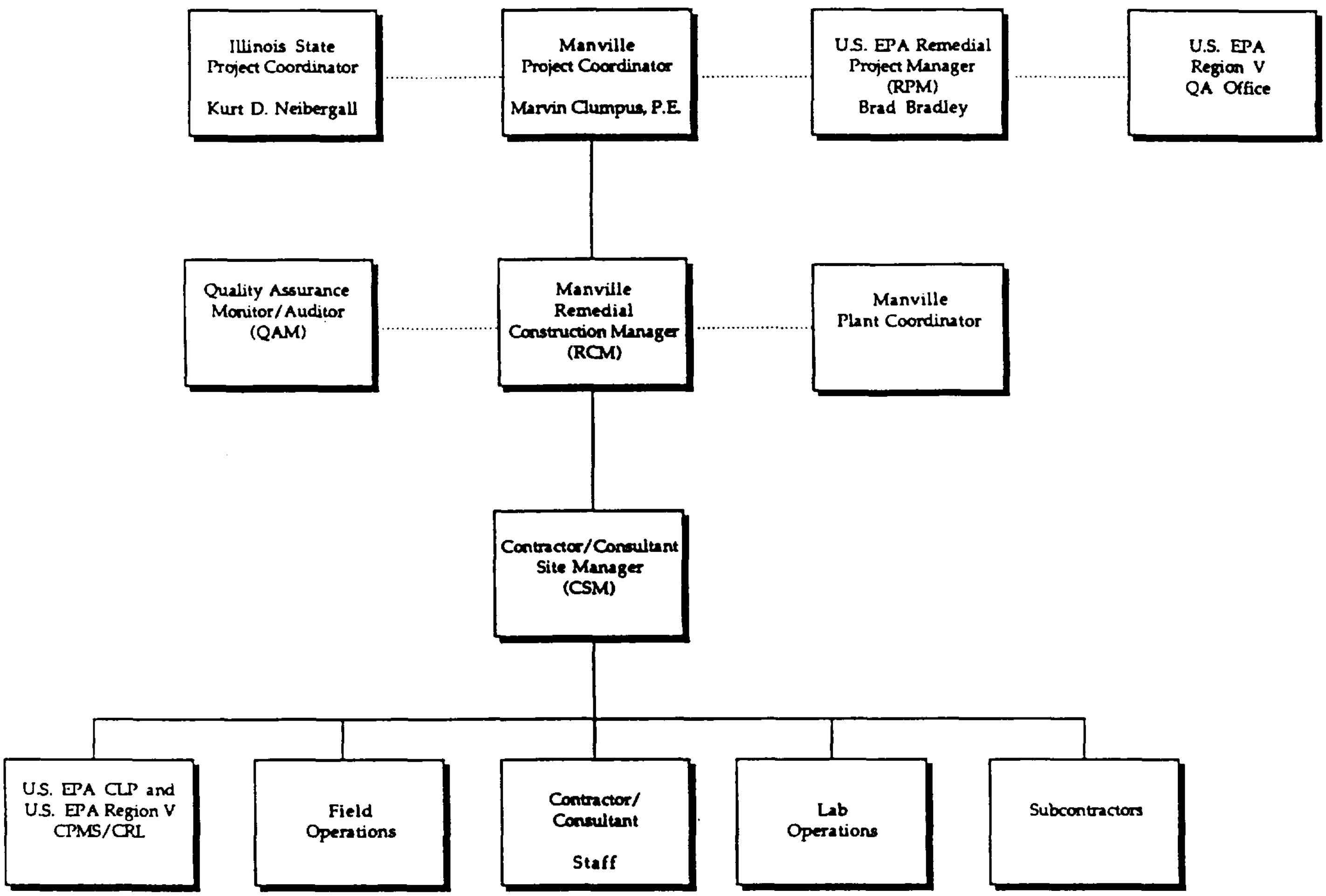


Figure C3-1

4.0 QA OBJECTIVES

4.1 Level of QC Effort

Field blanks, lab blanks, lab duplicates/replicates and calibration standards will be analyzed to provide a means to assess the quality of data resulting from the field sampling and lab analysis.

The general level of the QC effort for Post Remedial Construction Air Monitoring Activity will be analyses of one field blank for every group of sampling location on-site and off-site. Also, one sample filter will be analyzed as a lab replicate and one as the lab duplicate (a lab duplicate filter counted by different technician) for every ten or less samples (filters) collected from on-site sampling locations (excluding blanks). The lab replicate is defined as preparation and analysis of one more 3 square mm. (grid) filter piece by the same analyst. The lab duplicate analysis will involve one preparation only, but counting will be performed on the same grid by two analysts.

The general level of QC effort for pre-construction and first week of heavy construction air monitoring and perimeter air monitoring during construction will include the analysis of one field blank, one lab duplicate and one lab replicate for every ten or less samples to be analyzed by TEM method.

The general level of QC effort for short-duration, concurrent air monitoring during construction will be analysis of one field blank and one lab duplicate for every ten or less samples analyzed by PCM (NIOSH 7400) method.

4.2 Accuracy and Precision

The short duration, concurrent perimeter monitoring samples will be analyzed by Phase Contrast Microscopy (PCM) - NIOSH 7400 method. PCM method does not differentiate between asbestos or any other types of fibers. All selected 12-hour and 24-hour monitoring samples will be analyzed by transmission electron microscopy (TEM), as outlined in the "Methodology for the Measurement of Airborne Asbestos by Electron Miscoscopy", prepared by Yamate et al under U.S. EPA contract number 68-02-3266, which is the best available technique for differentiating asbestos fibers from non-asbestos fibers. Also, TEM allows measurement of small as well as large individual fibers. If bundles or clusters are present, TEM, like any other optical technique, will lead to underestimate fiber mass concentration. Fiber counts by TEM can be expected to range from 1 to 1000. Thus, from 1 to 3 significant figures may be reported. The precision for analysis of replicate/duplicate samples will be ±25%.

Sample sizes for post-remedial Construction asbestos air monitoring have been selected to ensure that asbestos fiber concentrations at the waste disposal site and off-site will be estimated with reasonable precision. If the coefficient of variation (standard deviation divided by the mean) is 150%, the estimated concentrations are expected to have estimation errors which are no greater than the true mean by $\pm 75\%$.

Estimated limit of detection by PCM is 7 fibers/mm^2 of the filter area.

4.3 Completeness, Representativeness and Comparability

The procedures used to obtain the analytical data, as documented herein, are expected to be complete, representative and will provide comparable data. It is expected that the labs chosen for analysis will provide data meeting QA criteria for 95 percent of all samples tested. All samples will be analyzed using same PCM or TEM Analytical Methods as discussed in Sections 4.1 and 4.2. The results will be expressed in fibers/c.c. of air at standard conditions. All samples will be collected by following the method specified in the QAPP. Chain of custody procedures will be carried out to preserve the integrity of the samples. Sample handling will be such that fibers deposited are not disturbed from the filters.

4.4 Facilities and Equipment

The field sampling equipment is identified in the monitoring/ sampling plans (Appendices C3-A and C3-B). Selected laboratories are properly equipped to perform the asbestos analyses. The selected laboratory will be subject to performance and system audits for approval/disapproval by the CPMS of U.S. EPA Region V.

5.0 SAMPLING PROCEDURES

Procedures to collect ambient air samples for asbestos analysis during different monitoring activities are described in the sampling/ monitoring plans presented in Appendices C3-A and C3-B.

6.0 SAMPLE CUSTODY

6.1 Sample Handling, Shipping and Custody

Samples will be handled and shipped as described in the sampling plans C3-A and C3-B. Each sample will be issued a unique project identification number to be determined in the field.

6.2 Field Documentation

A field logbook will be maintained and the following information will be recorded:

- Name and signature of field operator.
- Lot or assigned batch number (or any other identifiable number).
- Filter type e.g., Millipore (MCE), Nuclepore (polycarbonate).
- Date of record.
- Station Location and Number.
- Use of filter, (i.e., field blank, lab blank, or test blank).
- Condition of sample.
- Sample flow rate at start of sampling period.
- Start time.
- Stop time.
- Sample flow rate at end of sampling period.
- Any specific instructions/comments.

A traceability packing slip will be filled out in the field. The samples will be either hand carried or shipped to the laboratory for chemical analyses, where the package contents will be compared to the traceability packing slip (chain of custody). After the samples are logged in, they will be placed in suitable storage areas in the lab.

6.3 Project File

A project file will be maintained by Manville Remedial Construction Manager which will contain complete project documentation including project plans, specifications, field sampling documents, and the analytical data provided by the lab.

7.0 EQUIPMENT CALIBRATION

All field equipment, as appropriate, will be calibrated according to the standard operating procedures recommended by the manufacturer. Also, some of the field equipment will be calibrated as follows:

7.1 Rotameter Calibration

Rotameters will be checked, cleaned if necessary, then calibrated prior to the first sampling trip, as per the standard operating procedures. Air bubble calibration may be used for air flow calibration of rotameter as well as sampling pumps.

7.2 Dry Gas Meter Calibration

The Dry Gas Meter will be checked and calibrated prior to the start of the sampling event and once every week, as per the manufacturer's standard operating procedures.

All the laboratory equipment will be calibrated as per the laboratory's standard procedures and as prescribed herein.

7.3 TEM Calibration

The microscope shall be calibrated routinely for camera constant and magnification. The camera constant determination and ED pattern analysis will be achieved by using a carbon coated grid on which a thin film of gold has been sputtered or evaporated. The magnification calibration must be done on the fluorescent screen at the grid opening magnification (if used) and at the magnification used for fiber counting.

Standard materials of known asbestos type will be used as reference for fiber morphology and electron diffraction patterns.

National Bureau of Standards standard filter preparations of known asbestos concentration will be used to assess the accuracy of the TEM method.

For the TEM calibration, manufacturer's standard procedures and U.S. EPA recommended procedures will be used.

7.4 Routine calibration of microscope will include a calibration of Walton-Beckett graticule, a check of microscope adjustments, a check of phase-shift-detection limit, a quality control of fiber counts and reproducibility as per manufacturer's and OSHA's procedural guidelines as specified in Appendix A of 20CFR1926, published on June 20, 1986.

8.0 ANALYTICAL PROCEDURES

All air samples will be transported to the laboratory carrying out the chemical analysis and will be kept encoded during microscopic analyses. They will be decoded by the QA monitor after all analyses are completed. Upon receipt of filters, the laboratory will record in a laboratory logbook the sample numbers, date they were received, and any macroscopic identifying characteristics of particular filter samples. This includes damaged or smudged areas on the filter surface, lack of uniform sample deposition, unattached particulate or debris, unusually heavy-appearing deposit concentrations, or other evidence of unusual condition.

Analysis will be by PCM for short-duration, concurrent perimeter air samples and by TEM for all selected 12-hour and 24-hour monitoring air samples. One of the two laboratories, Clayton Environmental Consultants and Environmental Monitoring Systems (EMS) will be utilized for asbestos analysis.

8.1 Analysis by PCM

Analysis of filters by PCM method will be in accordance with procedures outlined in Appendix A of 29CFR 1926, published on June 20, 1986 and summarized below.

8.1.1 Fiber counts shall be made by positive phase contrast using a microscope with an 8 to 10 X eyepiece and a 40 to 45 X objective for a total magnification of approximately 400 X and a numerical aperture of 0.65 to 0.75. The microscope shall also be fitted with a green or blue filter.

8.1.2 The microscope shall be fitted with a Walton-Beckett eyepiece graticule calibrated for a field diameter of 100 micrometers (±2 micrometers).

8.1.3 The phase-shift detection limit of the microscope shall be about 3 degrees measured using the HSE phase shift test slide as outlined below:

a: Place the test slide on the microscope stage and center it under the phase objective.

b: Bring the blocks of grooved lines into focus.

Note: The slide consists of seven sets of grooved lines (20 grooves to each block) in descending order of visibility from sets 1 to 7, seven being the least visible. The requirements for asbestos, tremolite, anthophyllite, and actinolite counting are that the microscope optics must resolve the grooved lines in set 3 completely, although they may appear somewhat faint, and that the grooved lines in sets 6 and 7 must be invisible. Sets 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope that fails to meet these requirements has either too low or too high a resolution to be used for asbestos, tremolite, anthophyllite, and actinolite counting.

c: If the image deteriorates, clean and adjust the microscope optics. If the problem persists, consult the microscope manufacturer.

8.1.4 Each set of samples taken will include 10 percent field blanks for asbestos analysis. The blank field results shall be averaged and subtracted form the analytical results before reporting. Any samples represented by a field blank having a fiber count in excess of 7 fibers/100 fields shall be rejected.

8.1.5 The samples shall be mounted by the acetone/triacetin method or a method with an equivalent index of refraction and similar clarity.

8.1.6 Observe the following counting rules:

a: Count only fibers equal to or longer than 5 micrometers. Measure the length of curved fibers along the curve.

b: Count all particles as asbestos, tremolite, anthophyllite, and actinolite that have a length-to-width ratio (aspect ratio) of 5:1 or greater.

c: Fibers lying entirely within the boundary of the Walton-Beckett graticule field shall receive a count of 1. Fibers crossing the boundary once, having one end within the circle, shall receive the count of one half (1/2). Do not count any fiber that crosses the graticule boundary more than once. Reject and do not count any other fibers even though they may be visible outside the graticule area.

d: Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of an individual fiber.

e: Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields; stop counting at 100 fields regardless of fiber count.

8.1.7 Blind recounts (lab replicate) shall be conducted at the rate of 10 percent.

8.2 <u>Analysis by TEM</u>

Level II analysis, as stipulated in "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy" by Yamate, Agarwal & Gibbons under U.S. EPA contract no. 68-02-3266 will be carried out. Level II analysis will include Level I analysis plus chemical elemental analyses. Morphology, size, SAED pattern and chemical analysis will be obtained sequentially. By a process of elimination, mineral fibers will be identified as chrysotile, amphibole, ambiguous, or "no-identity" by morphology and SAED pattern. X-ray elemental analysis may be used to categorize the amphibole fibers, identify the ambiguous fibers,and confirm or validate chrysotile fibers. Alternately, the TEM method, utilized during earlier sampling during RI may be used as described below.

8.2.1 Any damaged areas removed prior to sample preparation will be mounted on glass slides using double-sided adhesive and the diameter of the effective filter area will be measured. The total effective filter area and damaged areas of sample removed should be accurately recorded for subsequent calculation of asbestos concentration.

8.2.2 Sample Preparation

If a Mixed Cellulose Ester (millipore) filter is used during sampling, then the sample preparation method utilized will be one of the methods presented in Section 7, page 61, of the "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy" by Yamate, et.al.

If the polycarbonate (nucleopore) filter is used during the sampling, then the procedures described in this Section (8.2.2) or as described in Section 5 of of the above mentioned document by Yamate et.al. shall be followed.

Attach the Nuclepore filter tautly to a clean, labeled (sample no., date) 1 x 3 in. glass slide. Coat the filter with an approximately 40-mm thick carbon film (National Spectroscopic Laboratories carbon rods) by vacuum evaporation. The film thickness need be sufficient only to provide support for the deposit sample.

Transfer the polycarbonate filter deposit to a 200-mesh electron microscopy copper grid (E.G. Fullam) by cutting a 3-mm square portion from the filter using a clean, single-edged razor blade. Place this deposit side down on the electron microscopy (EM) grid which, in turn, has been set upon a small, correspondingly labeled portion of lens tissue paper. Place the film, grid and lens paper on a Jaffe dish consisting of a copper screen supported on a bent glass rod in a covered 90-mm glass petri dish. Pour reagent grade chloroform (J.T. Baker Company) into the dish to saturate the lens paper without submersing the grid and sample. Keep the dish covered at room temperature for 2 hours. Shift the prepared sample to a clean petri dish with fresh chloroform. Heat to 40° C for 10 minutes to provide a washing procedure. While it is still wet, place the sample grid in a small gelatin capsule. Tape the capsule to the slide that has the remaining coated polycarbonate filter, and store until analysis.

8.2.3 Microscopic Procedure

Examine the EM grid under low magnification in the transmission electron microscope to determine its suitability for examination under high magnification. Ascertain that the loading is suitable and is uniform, that a high number of grid openings have their carbon film intact, and that the sample is not contaminated excessively with extraneous debris or bacteria.

Scan the EM grid at a screen magnification of 20,000X. Record the length and breadth of all fibers that have an aspect ratio of greater than 5:1 and have substantially parallel sides. Observe the morphology of each fiber through the 10X binoculars and note whether a tubular structure characteristic of chrysotile asbestos is present. Switch into selective area electron diffraction (SAED) mode and observe the diffraction pattern. Note whether the pattern is typical of chrysotile or amphibole, ambiguous, or neither chrysotile nor amphibole. Use energy disbursing X-ray analysis where necessary to further characterize the fiber. Take pictures as desired representing the sample type, fiber/particulate distribution, or characteristic SAED patterns of chrysotile and specific amphibole types.
Count the fibers in the grid openings until at least 100 fibers, or the fibers in a minimum of 10 grid openings, have been counted. Once counting of fibers in a grid opening has started, the count will be continued though the total count of fibers may be greater than 100. To insure uniformity of grid opening dimensions, examine several 200-mesh grids by optical microscopy and measure roughly 100 openings per grid. Average these dimensions to provide a standard grid opening area.

8.2.4 <u>Calculations</u>

Calculate using the following equation, fiber number concentration expressed as the total number of fibers/volume of air:

$$\text{Fiber Count} = \text{no. of fibers counted} \times \text{area* factor} \times \frac{\text{dilution factor**}}{\text{volume sampled, m}^3}$$
$$\text{f/m}^3$$

Where:

$$\text{*Area Factor} = \frac{(\text{total effective filter area, cm}^2)}{(\text{no of grids examined})\ (\text{average area of an EM grid opening, cm}^2)}$$

**Dilution factor takes into account sample dilution during ashing and refiltering and transfer to the EM Grid. The factor = 1.0 for samples collected on Nuclepore filters.

Calculate fiber mass for each type of asbestos in the sample by assuming that the breadth measurement is a diameter, thus, the mass can be calculated from:

$$\text{Mass (ug)} = \frac{\pi}{4}\left[(\text{length, um})\times(\text{diameter,um})^2\right]\ (\text{density, g/cm}^3)\times 10^{-6}$$

The density of chrysotile is assumed to be 2.6 g/cm^3. and of amphibole, 3.0 g/cm The mass concentration for each type of asbestos is then calculated from:

$$\text{Mass Concentration of a particular type } (ug/m^3) = \frac{\text{Total mass of all fibers of that type, ug)} \times \text{area factor} \times \text{dilution factor}}{\text{volume of air sampled } (m^3)}$$

Record the fiber bundles and clusters as such but do not include them in the mass calculation or the fiber count. The fiber clusters and fiber bundles are not included in the mass calculation because (1) it is difficult to assign the third dimension to the two-dimensional observation of the aggregates, (2) it is difficult to determine void space within bundles and clusters, and (3) since the bundles and clusters make up only about 2% of the item count, one cannot be certain of the even distribution throughout the filter.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

The analytical laboratory will review appropriate laboratory quality control data to assure the validity of the analytical results provided to the contractor. As a minimum, the guidelines listed below will be followed:

- When calculations are made by hand, 2 people will spot check some calculations independently and then compare results; correct if necessary.
- When computer is used, data entry will be verified; programs, formulae, etc., will be tested with sample data previously worked out by hand.
- When statistical software packages are used, tests of reason will be applied; on outputs, double-check sample sizes, degrees of freedom, variable codes, etc.; be alert for outliers.
- When reporting numerical results, computer generated outputs rather than retyped tables will be used to the extent possible. When possible, reported tables will be compared for consistency in variable codes and values, sample sizes, etc. In all cases, data validation activities shall be documented and records kept of any necessary corrective action in the appropriate notebook.

Full analytical and QC documentation will be prepared and retained by the laboratory. All raw data generated from analyses of samples, blanks, duplicates and replicates will be checked to meet established QA objectives and reported to the RCM/CSM. Where test data have been reduced, the method of reduction will be described in the lab report.

Standard statistical techniques will be used to estimate mean airborne asbestos concentration for the on-site and off-site samples collected during post Remedial Action air monitoring events. A 95% confidence interval will be obtained to provide a measure of the error involved in the estimation.

Comparisons between the disposal site and background concentrations will be made. Power (confidence level) calculations will be made to indicate the power of the statistical tests to detect differences between means.

No statistical techniques will be used to estimate fiber concentrations for samples collected during Pre-Remedial and during Remedial Construction monitoring activities.

10.0 INTERNAL QC CHECKS

The internal QC procedures associated with testing of asbestos will be in accordance with Section 4.0 of this document. Also, data entry checks and data transfer checks will be carried out as part of internal QC checks.

11.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits provide the primary means for external monitoring of this project. These audits will be performed during the field sampling by an individual appointed by the QA monitor.

11.1 Performance Audits

11.1.a

Device to be Audited	Audit Device
Pump	Flow Meters

11.1.b Performance Audit Procedure

- Verify calibration of the flow meters against standard reference device.
- Review EPA standard methods and/or other test protocols.
- directly measure flow rate against rotameter.
- Record all data on performance audit form. In general, all reported values should be within 10% as compared to the audit device.

11.2 System Audit

11.2.a Area to be Audited

- Entire sampling procedure

11.2.b System Audit Procedure

- Review test procedures and protocols.
- Obtain standard audit form.
- Observe the performance of each task.
- Ask questions as required.

The Quality Assurance Auditor is responsible for monitoring and auditing the performance of the QA procedures listed in this plan. He will maintain continuous communication with the RCM/CSM. Also, external audits may be performed by the Contract Project Management Section (CPMS) of Region V, Central Regional Laboratory (CRL).

12.0 PREVENTIVE MAINTENANCE

Preventive maintenance on all field equipment will be carried out in accordance with their standard operating procedures. A routine preventative maintenance program may be conducted by the laboratory for laboratory equipment.

13.0 DATA ASSESSMENT PROCEDURES

The Quality Assurance Monitor/Auditor will review the analytical results for compliance with established QC criteria. Any problems arising during sample collection, packing, shipping or analysis will be taken into consideration during the data assessment.

14.0 FEEDBACK AND CORRECTIVE ACTION

The types of corrective action procedures which will be used are:

- On-the-spot, immediate corrective action.
- Closed-loop, long-term corrective action.

14.1 On-the-Spot Corrective Action

This type of corrective action is usually applied to spontaneous, non-recurring problems, such as an instrument malfunction. The individual who detects or suspects non-conformance to previously established criteria or protocol in equipment, instruments, data, methods, etc., immediately notifies his/her supervisor. The supervisor and the appropriate task leader then investigate the extent of the problem and take the necessary corrective steps. If a large quantity of data is affected, the task leader must prepare a memo to CSM/RCM/Manville Project Coordinator and the Quality Assurance Monitor (QAM). These individuals will collectively decide how to proceed after due approval from U.S. EPA and IEPA Remedial Work representatives.

14.2 Closed-Loop, Long-Term Corrective Action

Long-term, corrective action procedures are devised and implemented in order to prevent the reoccurrence of a potentially serious problem. The QAM is notified of the problem and conducts an investigation of the problem to determine its severity and extent. The QAM then files a corrective action request with the appropriate Task Leader, with a copy to the CSM/RCM, requesting that corrective measures be put into place. Suggestions as to the appropriate corrective action will also be made. The U.S. EPA Remedial Project Manager is responsible for approval of the corrective action proposed by Manville Project Coordinator and QAM.

15.0 QUALITY ASSURANCE REPORTS

The complete and correct implementation of this QAPP will be reviewed by the RCM/CSM. Any deviation from this QAPP or any concern arising during the project requiring significant changes in the QAPP also will be identified by the RCM/CSM. The RCM/CSM will propose adjustments required to Manville Corporation, Project Coordinator and U.S. EPA. After approval by U.S. EPA he will ensure their implementation. The QA-related information will be included in the monthly progress reports to U.S. EPA, as applicable. No separate QA reports will be submitted.

16.0 SAMPLING PLANS

A plan for Ambient Air asbestos sampling/monitoring to be conducted after Remedial Construction is presented in Appendix C3-A. Appendix C3-B presents the sampling to be conducted before and during the Remedial Construction.

Table C3-A-1 (continued)

This is equivalent to

$$P\left(\frac{(n-1)s^2}{2} \leq \frac{(n-1)nd^2u^2}{^2(t_{0.025,n-1})^2}\right) = 1-B$$

If it is assumed that the n samples are independent observations from a normal distribution with mean u and variance σ^2 then $(n-1)(s^2/\sigma^2$ has a x^2 distribution with (n-1) degrees of freedom. The problem is thus reduced to finding n such that

$$\frac{(n-1)nd^2u^2}{\sigma^2[t_{(0.025,n-1)}]^2} = x_{n-1}$$

where x_{n-1} is the upper (100%) B percentage point of the x^2_{n-1} distribution. Substituting $\sigma^2 = c^2u^2$ gives

$$n= \frac{1+ 4[t_{(0.025,n-1)}]^2 (c/d)^2 x_{n-1}}{2}$$

which can be solved by trial and error.

Table C3-A-2 shows the values of n for different values of the coefficient of variation (c), the size of the 95% confidence probability of obtaining an error as small or smaller. For example, if the coefficient of variation is 100% and one wants to ensure with probability 0.95 that the estimation error is no greater than ±50% of the true mean, then 27 samples are required. If only 22 samples are collected then the probability is reduced to 0.8.

TABLE C3-A-1

Calculating Sample Sizes

The term "estimation error", as used in this plan refers to half of the length of the 95% confidence interval for the true mean. This confidence interval will be calculated from the data after they have been collected and will indicate the magnitude of the error associated with the estimation of the true mean. If the coefficient of total variation is small and/or the sample size is large, then the confidence interval will be short and one will be confident that the true mean is not very different from the value estimated from the data. By "confident" it is meant that 95% of the time the procedure for calculating a 95% confidence interval results in an interval which actually includes the true mean.

The formula for the 95% confidence interval is:

$$\bar{x} \pm t_{(0.025,\ n-1)}\sqrt{s^2/n}$$

where $\bar{x}$ and s^2 are the calculated sample mean and sample variance, respectively, and t(0.025, n-1) is the upper 2.5 percent point of the t distribution with n-1 degrees of freedom. Note that

$t_{(0.025,n-1)}\sqrt{s^2/n}$ is the estimation error. The aim is to

choose the sample size n so that $t(0.025,n-1)\ \sqrt{s^2/n}$

is not too large. Suppose it is decided that this quantity should be no larger than d where is the true mean and d is a fixed proportion. For example, if the estimation error is required to be no more than 60% of the mean, then d would be made equal to 0.6. Then n has to be chosen so that

$$t_{(0.025,n-1)}\sqrt{s^2/n} \text{ is less than du.}$$

It is not possible to be absolutely sure that for a given sample size the resulting confidence interval is sufficiently small, but it is possible to attach a probability to the chance that it will be. For example, it is possible to find n such that the probability that the confidence interval is sufficiently small is 0.9 or 0.95, or any other desired level. If the desired level is 1-B then it is necessary to find n such that

$$P[\ t_{(0.025,n-1)}\sqrt{s^2/n} \le du] = 1-B$$

Table C3-A-1 (continued)

This is equivalent to

$$P\left(\frac{(n-1)s^2}{2} \leq \frac{(n-1)nd^2u^2}{^2(t_{0.025,n-1})^2}\right) = 1-B$$

If it is assumed that the n samples are independent observations from a normal distribution with mean u and variance σ^2 then $(n-1)(s^2/\sigma^2$ has a x^2 distribution with (n-1) degrees of freedom. The problem is thus reduced to finding n such that

$$\frac{(n-1)nd^2u^2}{\sigma^2[t_{(0.025,n-1)}]^2} = x_{n-1}$$

where x_{n-1} is the upper (100%) B percentage point of the x^2_{n-1} distribution. Substituting $\sigma^2 = c^2u^2$ gives

$$n = \frac{1+4[t_{(0.025,n-1)}]^2 (c/d)^2 x_{n-1}}{2}$$

which can be solved by trial and error.

Table C3-A-2 shows the values of n for different values of the coefficient of variation (c), the size of the 95% confidence probability of obtaining an error as small or smaller. For example, if the coefficient of variation is 100% and one wants to ensure with probability 0.95 that the estimation error is no greater than ±50% of the true mean, then 27 samples are required. If only 22 samples are collected then the probability is reduced to 0.8.

TABLE C3-A-2

*The Relationship Between Sample Size, Coefficient of Variation, and Estimation Error

Coefficient of Variation[a]	Maximum acceptable estimation error as a percentage of the true mean[b]	Required Sample Size[c] 80%	90%	95%
100%	25%	73	78	81
	50%	22	25	27
	60%	17	19	30
	75%	13	14	15
	80%	12	13	14
	100%	9	10	11
150%	25%	154	160	176
	50%	44	48	50
	60%	32	35	38
	75%	22	25	27
	80%	21	22	24
	100%	15	16	17

[a] Standard deviation divided by the mean and expressed as a percentage.

[b] Based on the 95% confidence interval for the true mean calculated from the observed data.

[c] The number of samples required to ensure that the estimation error is less than the specified amount in the second column, with a probability of 80%, 90% and 95%.

*Reproduced from Exhibit J of June 14, 1984 Consent Decree for RI/FS at Johns-Manville Disposal Area between U.S. EPA and Johns-Manville Sales Corporation.

Manville Disposal Area between U.S. EPA and Johns-Manville Sales Corporation (see RI Volume II). Based on this data, a minimum of 25 samples on the site will be collected. This sample size would provide an estimation error of $\pm$ 50% of the true mean at a coefficient of variation of 100%; or an estimation error of $\pm$ 75% if the coefficient of variation is 150%, with a 90% probability.

For measurements at the off-site/background locations, a larger estimation error is tolerable. A sample size of 10, collected at two locations, should suffice.

2.2 Sampling Locations

To achieve 25 on-site and 10 off-site samples, five on-site and two off-site locations have been selected as per U.S. EPA's suggestions. These off-site and on-site sampling locations are presented in Figures C3-A-1 and C3-A-2, respectively.

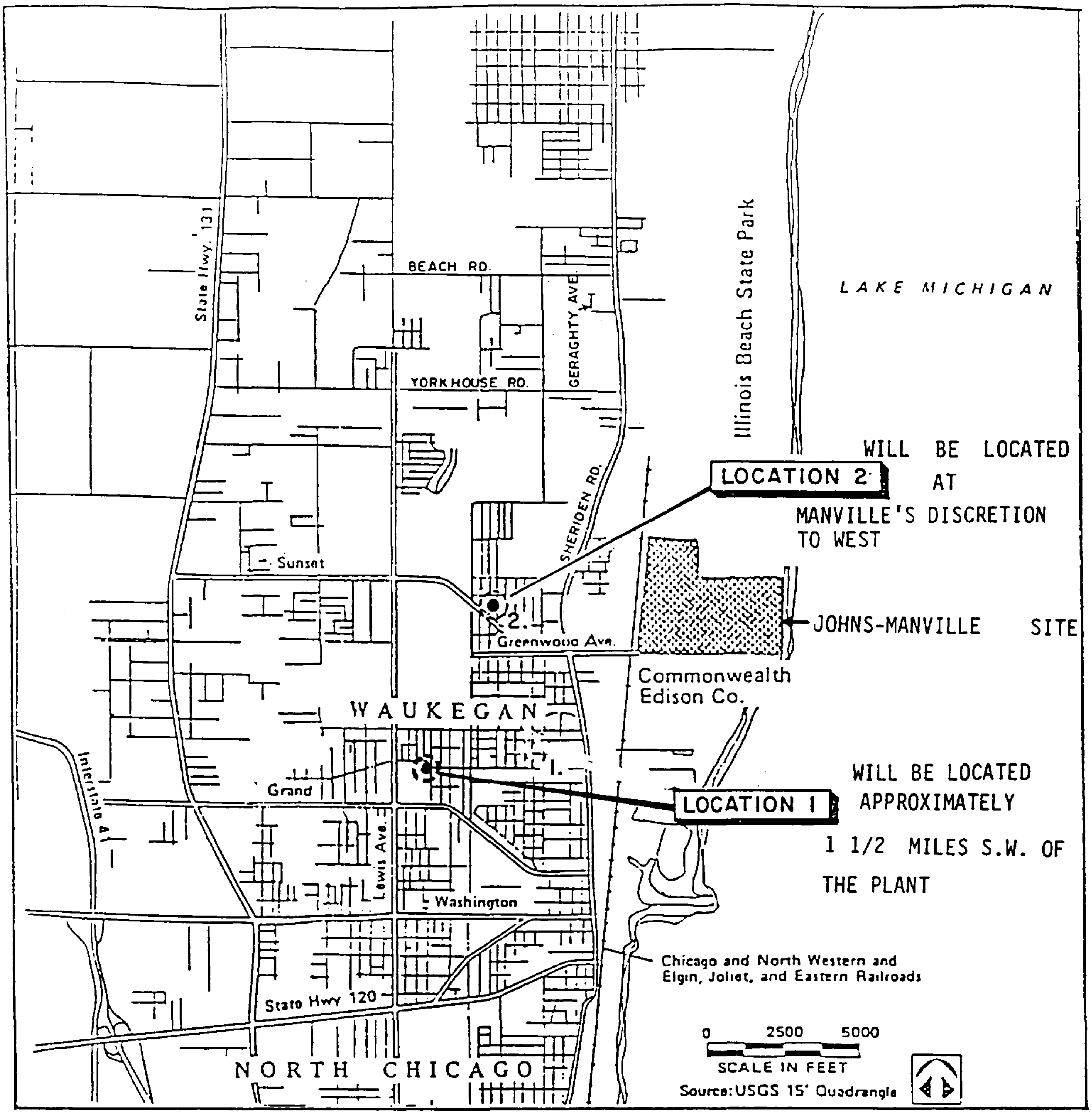
2.3 Sampling Times, Volumes and Filter Selection

To obtain comparable data with earlier air sampling events at this site and based on the likelihood of day-to-day variability in on-site activity and meteorological conditions; sampling will be conducted on five separate days, each, with a sampling period of 12$\pm$ hours.

If dust or any other non-asbestos containing particles are present in the air at high concentrations, they will overload (clog) the filters if high sampling flow rates are utilized.

Establishing a soil and vegetative cover should alleviate the problems of any excessive dust particles in the air. Preloaded cassettes with Mixed Cellulose Ester filters (25 mm or 37 mm diameter, with pore size of 0.45 microns or less) or polycarbonate filters (37 mm diameter, with pore size of 0.40 micron or less) will be utilized for sampling. Approximately 1200 to 1800 liters of air flow for a 25 mm. diameter filter or 2600 to 4000 liters of air flow for a 37 mm diameter filter will be used per sample.

A flow control orifice will be used in the assembly, if lower flow rates are warranted, due to filter clogging problems.

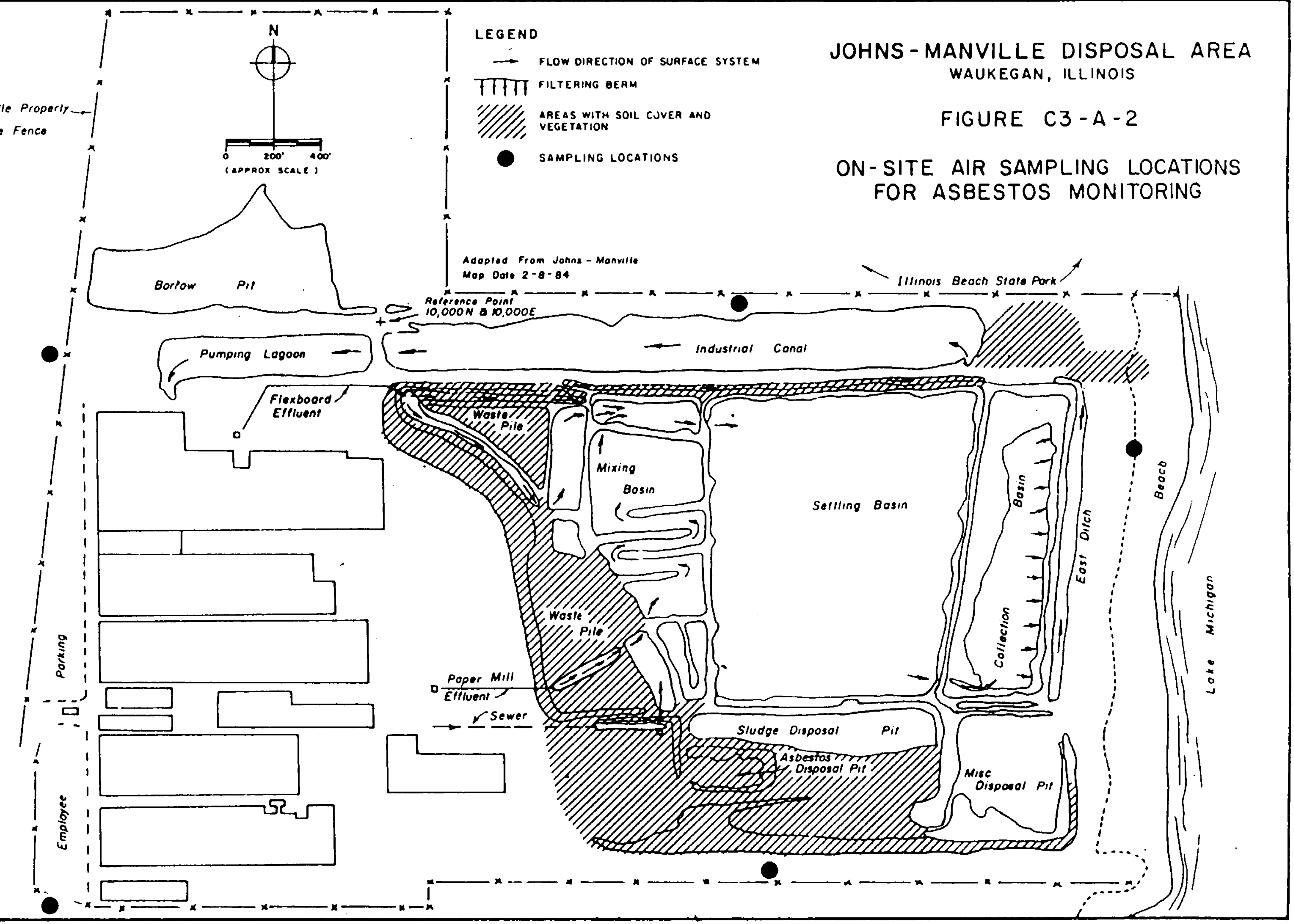


LEGEND

OFF-SITE LOCATIONS

JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

FIGURE C3-A-1



JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

FIGURE C3-A-2

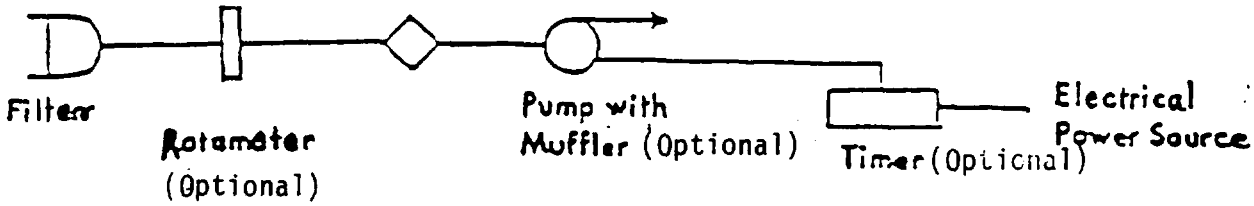
ON-SITE AIR SAMPLING LOCATIONS FOR ASBESTOS MONITORING

3.0 EQUIPMENT AND SAMPLER SETUP

3.1 The sampling system includes:

- An open-face filter holder
- A flow control orifice
- A pump with muffler
- A method of measuring sampling time

A sampler setup during calibration can be schematically as follows:



Air bubble calibrator may be used for pump calibration.

3.2 Equipment for Meteorological Observations

A wind vane and anemometer shall be used to record wind direction and speed on site. Recorded data will then be used to draw a wind rose for each day of sampling. Wind velocity and direction measurements at each of the sampling locations, twice per day, may be used instead of the recorded data collection at one location.

4.0 SAMPLING PROCEDURES

4.1 Sampling Protocol

- Number the filter cassette on outside.
- Place the filter cassette in the clamp such that it is oriented downward at approximately 45 degrees from the horizontal.
- Start the pump and check plumbing for leak.
- Check the flow with flowmeter.
- Ensure that the mechanical vibrations from the pump are minimal.
- Make appropriate log book entries.
- Conduct sampling.
- After sampling period, check flow with flowmeter and record it. Record the time on timer and record it.
- Stop the pump, remove the cassette and cap it.
- Place the cassette in a cassette holder.
- Prepare for the transportation as required.

4.2 Laboratory Blanks

Use filter cassettes from the same production lot number, if possible. Prior to field sampling, select six filter cassettes (at least one per box) to serve as laboratory blanks and keep in laboratory until analysis. These blanks are used to check that the filters are not contaminated prior to or after sampling. At least one of these filters will be analyzed for asbestos.

4.3 Field Blanks

During each of the five sampling periods, randomly select one field blank (filter cassette) from a new box of filter cassettes at each sampling site (i.e., on-site and off-site). This will result in a total of approximately 10 field blanks. Encode and handle the blank filters according to the same protocol as the test filters. Only one blank filter for on-site and off-site group of locations will be analyzed for asbestos. The total number of field blanks to be analyzed will be two for every sampling event.

5.0 SAMPLE ANALYSIS

Total number of on-site and off-site samples, number of field and lab blanks, number of duplicates and replicates to be analyzed in the lab are specified in Table C3-A-3.

6.0 PERSONAL PROTECTIVE EQUIPMENT AND DECONTAMINATION

Level D personal protection will be utilized, including:

- Disposable Tyvek coveralls,
- Outer gloves,
- Steel-toed boots

unless the Site Safety Officer determines that greater protection is needed.

Personnel decontamination will be conducted as described in the Health and Safety Plan (Attachment G) of the Work Plan. Outer gloves will be decontamined at the end of each sampling period. Wash and rinse solutions can be disposed of on site.

7.0 SAMPLE DOCUMENTATION

An important part of any field program are the observations and accurate records of the field team. As a minimum, logbook entries shall include:

- Name of field operator
- Date of record
- Number and location of site
- Position of sampler within site
- Brief site description (sketch)
- Filter number
- Identification number of pump and timer

TABLE C3-A-3

NUMBER OF SAMPLES AND ASBESTOS ANALYSES

	Field Blanks		Test Samples (filters)		Within the lab	Within the lab	Laboratory
	Off Site	On Site	Off Site	On Site	Duplicate	Replicate	Blanks
Filters to be Collected in the field	5	5	10	25	-	-	-
Filters to be Collected in the lab	-	-	-	-	-	-	6
Filters to be Analyzed	1	1	10	25	3	3	1

Total analyses within lab = 44

- Sample flow rate at start of sampling period
  - Start time
  - Stop time
  - Sample flow rate at end of sampling period
  - Wind rose for the sampling period
  - Description of meteorological conditions
  - Comments

8.0 SAMPLE PRESERVATION, PACKAGING AND SHIPPING

After the completion of sampling for 12± hours, filter will be handled in accordance with the following instructions:

- Before stopping the pump, rotate filter to horizontal position, stop the pump and remove the cassette.

- Cap the cassette and place in a cassette holder.

- Using a rigid shipping container, pack the holder upright in a non-contaminating, non-fibrous medium such as "bubble pack". Expanded polystyrene will not be used because of its static charge potential.

- Include a traceability slip (chain-of-custody) detailing number of samples, their descriptions, and all identifying numbers or marks, sampling data, shippers name, etc.

- Pack and transport the samples in a container to the laboratories for analyses.

- Label the transporting container in a way that will keep the holders and the filter cassettes in a horizontal position.

APPENDIX C3-B

AMBIENT AIR SAMPLING PLAN, FOR ASBESTOS, BEFORE AND DURING REMEDIAL CONSTRUCTION

AMBIENT AIR SAMPLING PLAN FOR ASBESTOS BEFORE AND DURING REMEDIAL CONSTRUCTION

1.0 INTRODUCTION

This sampling plan presents the sampling locations, sampling frequency, sampling and sample handling procedures to be followed during the sampling events to be conducted before and during initial phases of Remedial Construction Work.

Pre-Remedial Construction sampling for airborne asbestos will be conducted before the start of grading activities. This sampling event will be conducted once, for a period of five days. The data obtained will indicate the existing airborne asbestos concentrations, if any, and serve as background data for other sampling activities to be conducted during Remedial Construction.

Also, long-duration (24 hours) perimeter air monitoring and short-duration (4-8 hours) concurrent perimeter air monitoring will be conducted during initial phases of Remedial Construction Work. Initial phases of Remedial Construction involve site grading and smoothing and placement of the first layer of sand/soil cover. Data obtained by long-duration perimeter air sampling will be utilized to assess the potential impact on the surrounding environment of on-going Remedial Construction, and to implement additional dust suppressing measures, if any are desired. The monitoring results obtained will be compared to the 24-hour pre-remedial Construction air monitoring data. In the absence of any guideline on ambient air asbestos fiber concentrations, 0.02 fibers/cubic centimeters by PCM and 0.01 fibers/cubic centimeters by TEM, for fibers greater than 5 microns in length will be used for routine evaluation of dust-suppressing activities. The data obtained by short-duration concurrent perimeter monitoring will be used to identify the long-duration air sample to be analyzed by TEM as well as to indicate the potential short-term impact of Remedial Construction on the surrounding environment.

Personal air monitoring will also be conducted during the initial phases of Remedial Construction work, as presented in Appendix G-C of the Health and Safety Plan.

2.0 SELECTION OF SAMPLING LOCATIONS, NUMBER, FREQUENCY, TIMES AND VOLUME

2.1 Sampling Location and Number

Selection of sampling locations for long-duration perimeter monitoring as well as short-duration concurrent perimeter monitoring will be dependent upon the prevailing wind direction on each work day. Depending upon the observed and forecasted wind direction, sampling locations upwind and downwind of the Construction Area will be chosen. Also, meteorological measurements will be made by a portable, battery-operated recording anemometer placed at a suitable location in the vicinity of the Remedial Construction Area. The anemometer will be positioned at a height equivalent to the top of the Disposal Area so as to monitor local wind conditions. Wind speed and direction will be routinely decoded in order to select samples for analyses during the program. Wind velocity and direction measurements at each of the sampling locations, twice per day, may be used instead of the recorded data collection at one location. Three perimeter sampling locations will be chosen each workday, depending upon the heavy construction area and prevailing winds, for long-duration perimeter monitoring activities. Of these three sampling locations, two locations representing conditions downwind of the heavy construction area will be chosen for short-duration concurrent perimeter monitoring.

The three perimeter sampling locations will be chosen from several available perimeter sites, shown in Figure C3-B-1.

Long-duration perimeter monitoring during initial phases of Remedial Construction will involve sampling for a 24-hour duration each work day at each of the three sites. Short-duration, concurrent perimeter monitoring will involve sampling for a 4-8 hour duration each work day.

2.2 Sampling Frequency, Times and Volumes:

The long-duration and short-duration perimeter air monitoring will be conducted before and during initial phases of Remedial Construction.

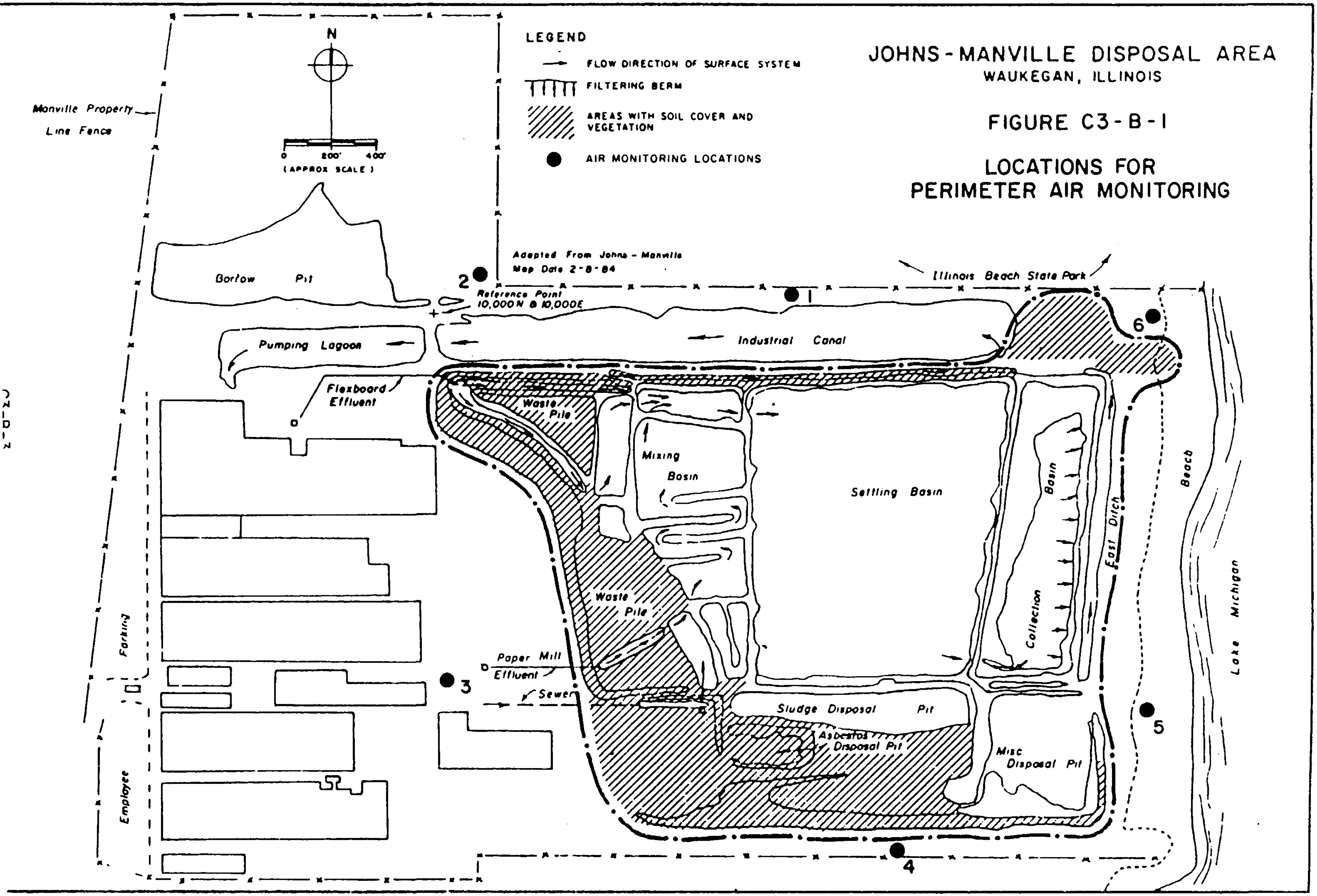
Twenty-four (24$\pm$1) hours sample will be collected each work day during long-duration perimeter air sampling. Calibrated Nutech- or equivalent samplers with preloaded cassette carrying MCE filter (25 mm or 37 mm diameter, 0.45 micron pore size) or polycarbonate filter (37 mm diameter, 0.40 micron pore size) will be used. A nominal, air sample total volume of 1200 to 1800 liters for a 25 mm filter or 2600 to 4000 liters for a 37 mm filter will be used.

Four to eight (4-8) hour samples will be collected each work day during short-duration concurrent perimeter air monitoring. Portable samplers with precalibrated pumps and filter cassettes (preloaded with 25 or 37 mm MCE filters or 37 mm polycarbonate filters) will be used to sample approximately 1200 to 1800 liters (for a 25 mm filter) or 2600 to 4000 liters (for a 37 mm filter) of air.

3.0 EQUIPMENT AND SAMPLER SETUP

A schematic diagram of a Nutech sampler is presented in figure C3-B-2. This sampler or an equivalent sampler setup will use a preloaded 25 mm or 37 mm filter cassette.

The short-duration concurrent perimeter sampler will utilize a mixed cellulose ester filter preloaded in a filter cassette.


LEGEND
FLOW DIRECTION OF SURFACE SYSTEM
FILTERING BERM
AREAS WITH SOIL COVER AND VEGETATION
AIR MONITORING LOCATIONS
JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS
FIGURE C3-B-1
LOCATIONS FOR PERIMETER AIR MONITORING
N
0
200'
400'
(APPROX SCALE)
Manville Property Line Fence
Adapted From Johns-Manville
Map Date 2-8-84
Illinois Beach State Park
Borrow Pit
Reference Point
10,000N & 10,000E
Pumping Lagoon
Industrial Canal
Flexboard Effluent
Waste Pile
Mixing Basin
Settling Basin
Collection Basin
East Ditch
Beach
Lake Michigan
Waste Pile
Paper Mill Effluent
Sewer
Sludge Disposal Pit
Asbestos Disposal Pit
Misc Disposal Pit
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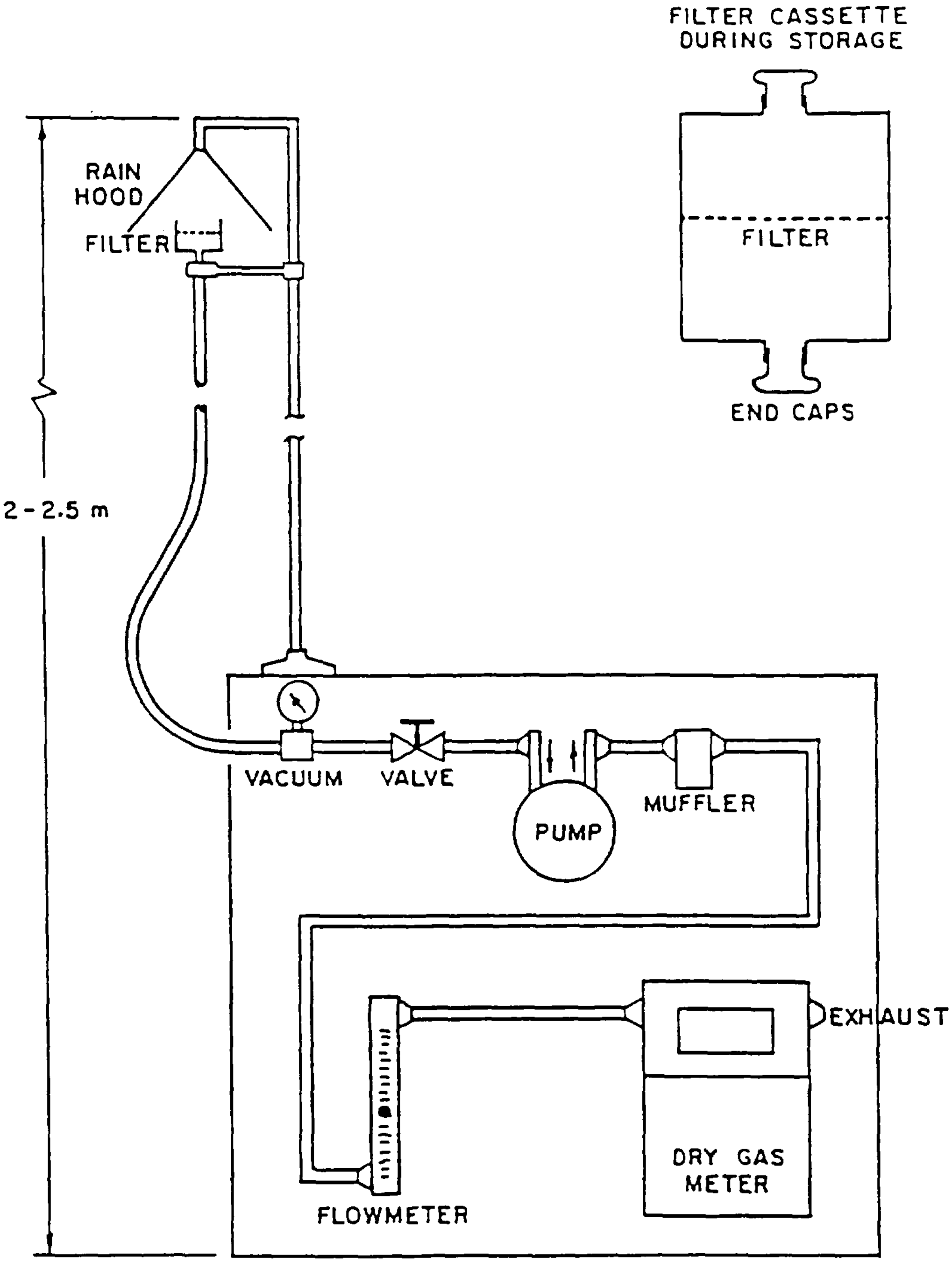

Fig. C3-B-2 SCHEMATIC OF AMBIENT AIR NUTECH SAMPLER

4.0 SAMPLING PROCEDURE

4.1 Sampling Protocol

Manufacturer's and U.S. EPA's published standard sampling techniques will be used.

4.2 Field Blanks

Field Blanks will be encoded and handled according to the same protocol as the test filters .

5.0 SAMPLE ANALYSIS

The total number of samples, field duplicates, lab duplicates and lab replicates to be collected and analyzed during short-duration and long-duration perimeter air sampling to be conducted during the initial phases of Remedial Construction are presented below:

	Filter Blanks		Test Samples		Lab Duplicates		Lab Replicates	
	A	B	A	B	A	B	A	B
Filters to be collected in field	2 per week	2 per week	3 per workday	3 per workday	-	-	-	-
Filters to be Analyzed	1 for every ten samples analyz.	1 for every ten samples analyz.	1 per week	3 per day	1 for every ten samples analyz.	1 for every ten samples analyz.	1 for every ten samples analyz.	1 for every ten samples analyz.

A = Long-duration air monitoring (By TEM)
B = Short-duration air monitoring (By PCM)

Also, during the first week of Remedial Construction, heavy construction work is anticipated. During this week and a week prior to the start of Remedial work, one long-duration perimeter air sample per day will be selected from downwind samples and analyzed by TEM. Hence, five long-duration perimeter monitoring air samples will be analyzed for the one week prior to beginning Remedial Construction and five samples will be analyzed for the first week of heavy construction (total = 10). One field blank, one lab duplicate and one lab replicate will be analyzed in addition to the five samples selected during each of the two weeks.

6.0 PERSONAL PROTECTIVE EQUIPMENT AND DECONTAMINATION

Modified Level D personnel protection will be utilized, including:

- Disposable Tyvek coveralls,
- Dust mask,
- Outer gloves,
- Steel-toed boots;

unless the Site Safety officer determines that greater protection is warranted.

Personnel decontamination will be conducted as described in the Health and Safety Plan (Attachment G) of the Work Plan. Outer gloves will be decontaminated at the end of each sampling period. Wash and rinse solutions can be disposed of on-site.

7.0 SAMPLE DOCUMENTATION

An important part of any field program are the observations and accurate records of the field team. As a minimum, logbook entries shall include:

- Name of field oerator
- Date of record
- Number and location of site
- Position of sampler within site
- Brief site description (sketch)
- Filter cassette number
- Identification number of pump and timer
- Sample flow rate at start of sampling period
- Start time
- Stop time
- Sample flow rate at end of sampling period
- Description of meteorological conditions
- Comments

8.0 SAMPLE PRESERVATION, PACKAGING AND SHIPPING

Throughout the sampling activities both Nuclepore and cellulose ester filters will be loaded in individual filter cassettes in a clean room.

After the pump has been stopped, filter will be handled in accordance with the following steps:

- Remove the filter cassette.

- Cap the cassette and place in a cassette holder.

- Using a rigid shipping container, pack the holder upright in a non-contaminating, non-fibrous medium such as "bubble pack". Expanded polystyrene will not be used because of its static charge potential.

- Include a traceability slip (chain-of-custody) detailing number of samples, their descriptions and all identifying numbers or marks, sampling data, shipper's name, etc.

- Pack and transport or hand carry the samples in a container to the laboratories for analyses.

- Handle the container in a way that will keep the holders and the filter cassettes in a horizontal (flat) position at all times (Handling, transport and storage).

RECORD DRAWING SET

FOR REMEDIAL CONSTRUCTION WORK
FORMER JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

Prepared for:

Schuller International, Inc.
Littleton, Colorado
(Formerly Known as Manville Sales Corporation
Denver, Colorado)

DECEMBER 1992
REF. NO. 2980(3)
(Printed on Recycled Paper)

CONESTOGA-ROVERS & ASSOCIATES

LIST OF DRAWINGS

DRAWING NO.	TITLE
PLAN 1	COVER SHEET
PLAN 2	SITE PLAN
PLAN 3	SITE PLAN INDEX
PLAN 4	INDEX AREA - PLAN 4
PLAN 5	INDEX AREA - PLAN 5
PLAN 6	INDEX AREA - PLAN 6
PLAN 7	INDEX AREA - PLAN 7
PLAN 8	MISCELLANEOUS SECTIONS
PLAN 9	MISCELLANEOUS SECTIONS
PLAN 10	MISCELLANEOUS PLAN AND SECTIONS
PLAN 11	MISCELLANEOUS DETAIL AND SECTIONS
PLAN 12	PROFILE AND DETAILS
PLAN 13	MISCELLANEOUS DETAILS
PLAN 14	MISCELLANEOUS DETAILS

SDMS US EPA REGION V
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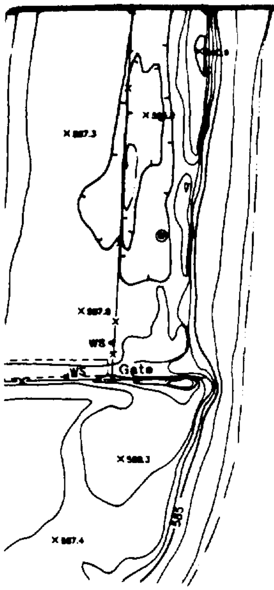
COMMENT(S)			
PLAN 1 -14 **(ITEMS PARTIALLY SCANNED)**			

LEGEND

	UTILITY POLE
	POLE W/ LIGHT
	STREET LIGHT
FH	FIRE HYDRANT
FP	FLAG POLE
S	SIGN
WS	PERIMETER WARNING SIGN
——x——	FENCE
■ CB	CATCH BASIN/DRAIN
● MH	MANHOLE
•	SMALL POST
	SWAMP AREA
△ BM-1	BENCHMARK AND ELEVATION
◉ MW-1	MONITORING WELL
⊙ T-1	VERTICAL AND HORIZONTAL CONTROL
x 615.0	SPOT ELEVATION
• BLP	BUOY LINE POST
T.O.C.	TOP OF CASING
EL.	ELEVATION
	DECIDUOUS TREE
	CONIFEROUS TREE
	CLASS I GRAVEL
	CLASS II GRAVEL
	RIPRAPS
	CLAY
	TOPSOIL
	12" GRAVEL COVER



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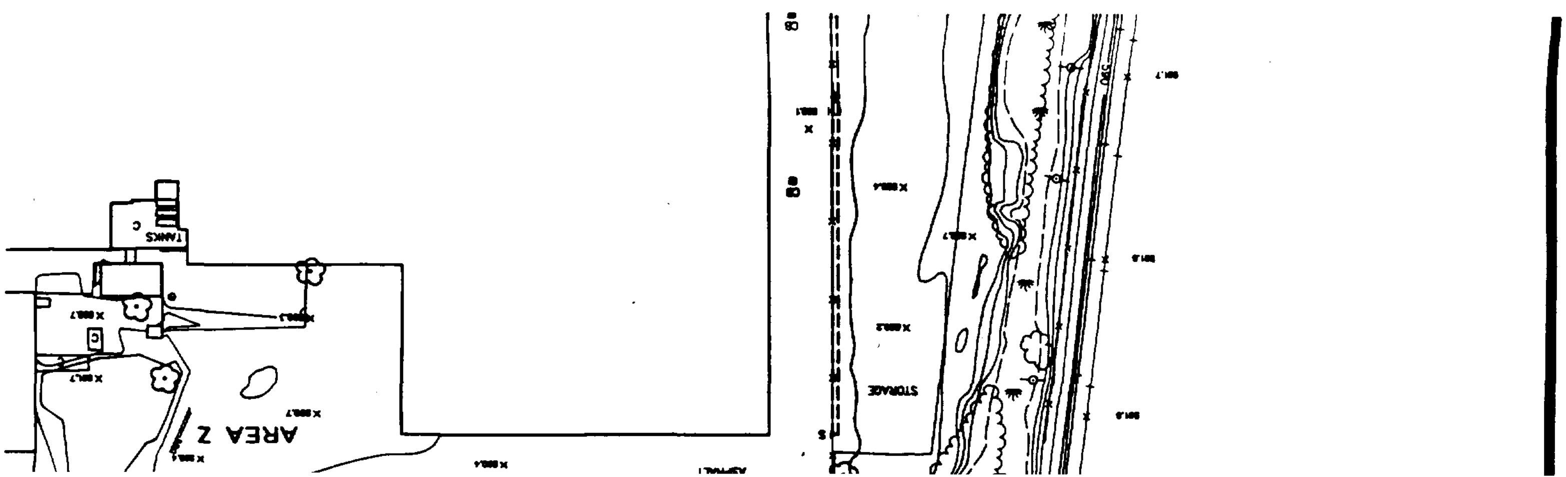

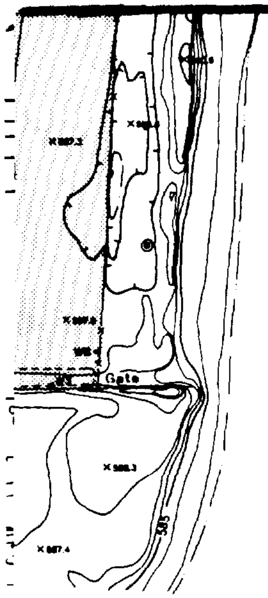

ɴVILLE DISPOSAL AREA
N, ILLINOIS

STRUCTION WORK

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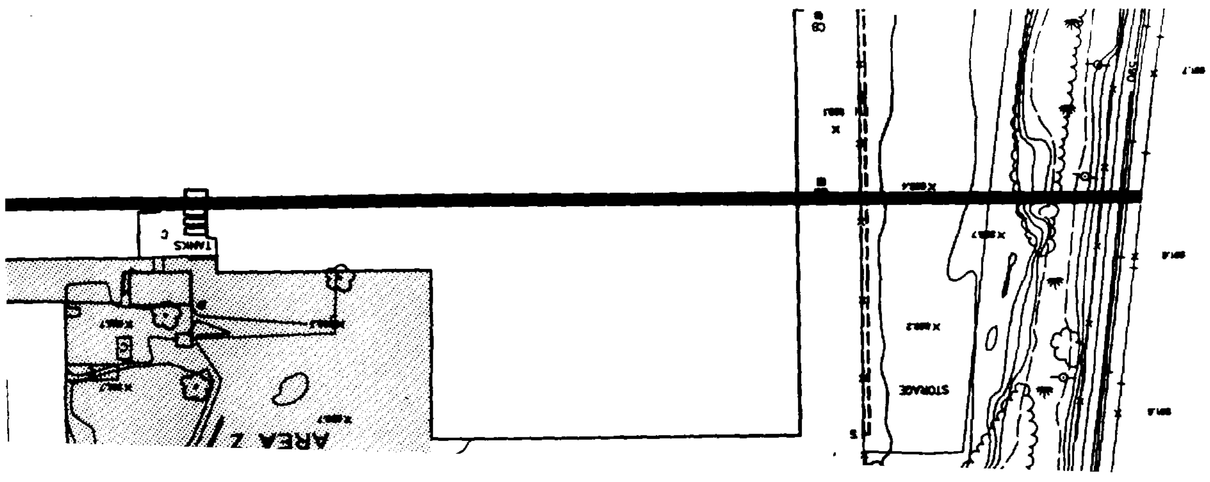

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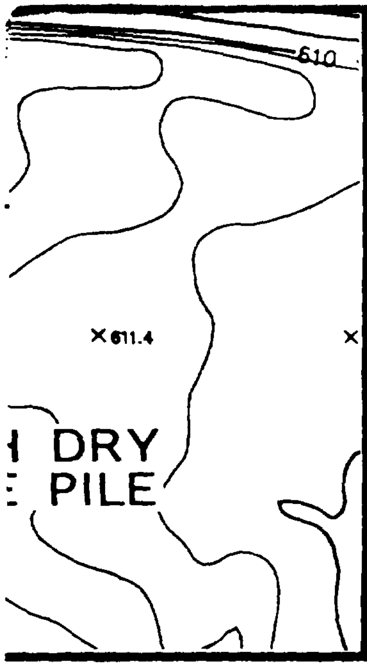

MANVILLE DISPOSAL AREA
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REA – PLAN 4

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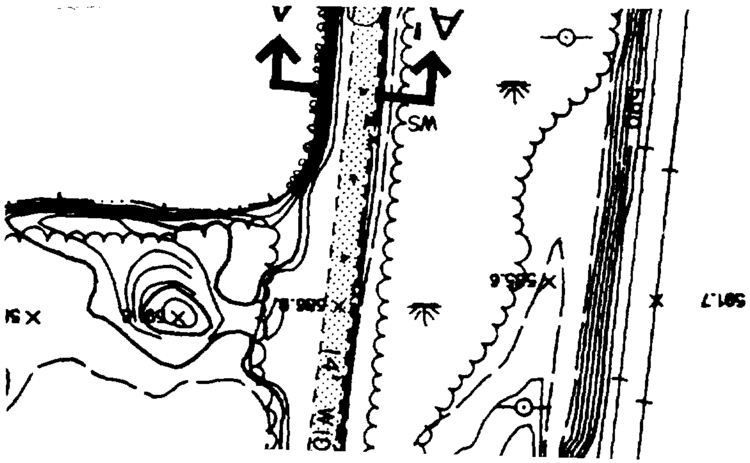

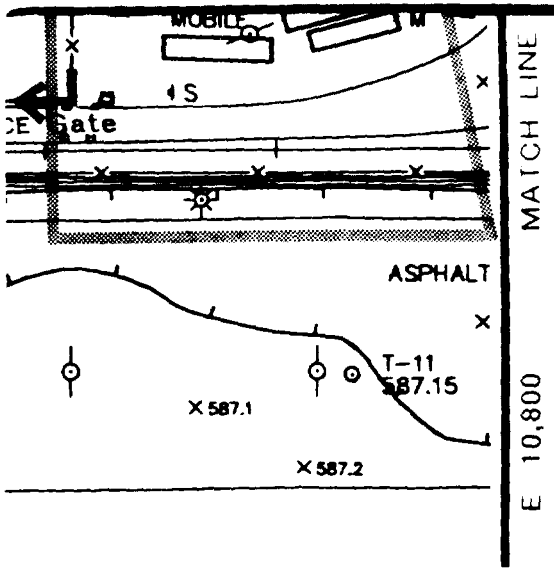

MANVILLE DISPOSAL AREA
GAN, ILLINOIS

ONSTRUCTION WORK

REA - PLAN 5

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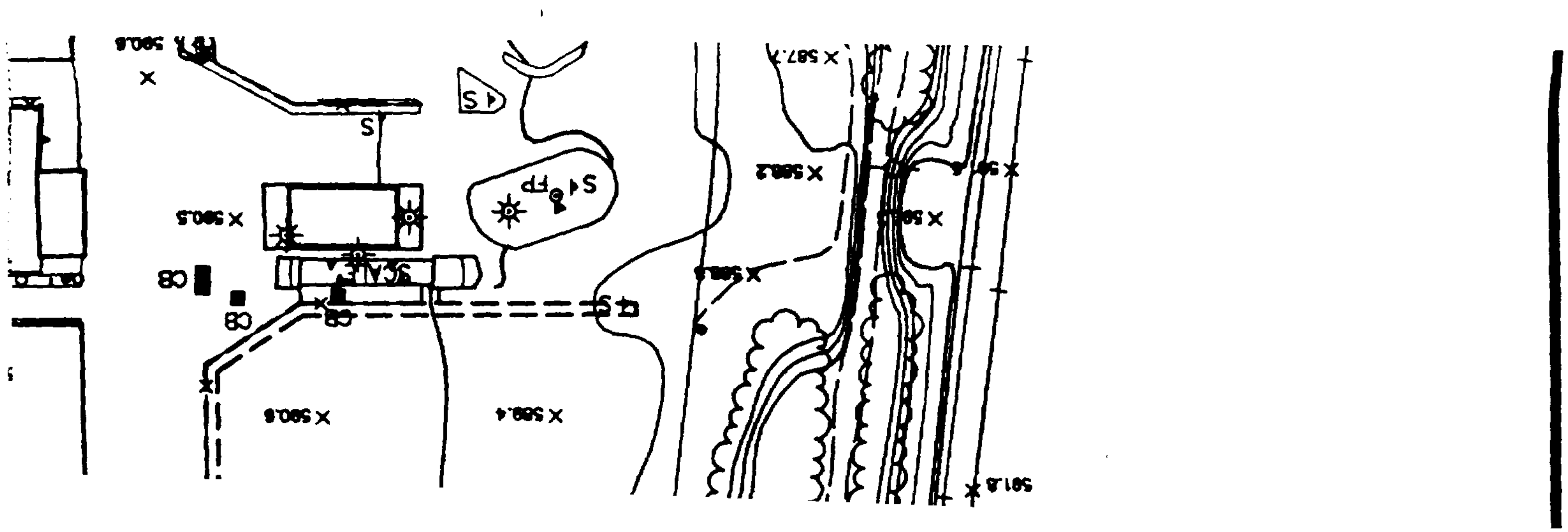

IANVILLE DISPOSAL AREA
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ONSTRUCTION WORK

REA - PLAN 6

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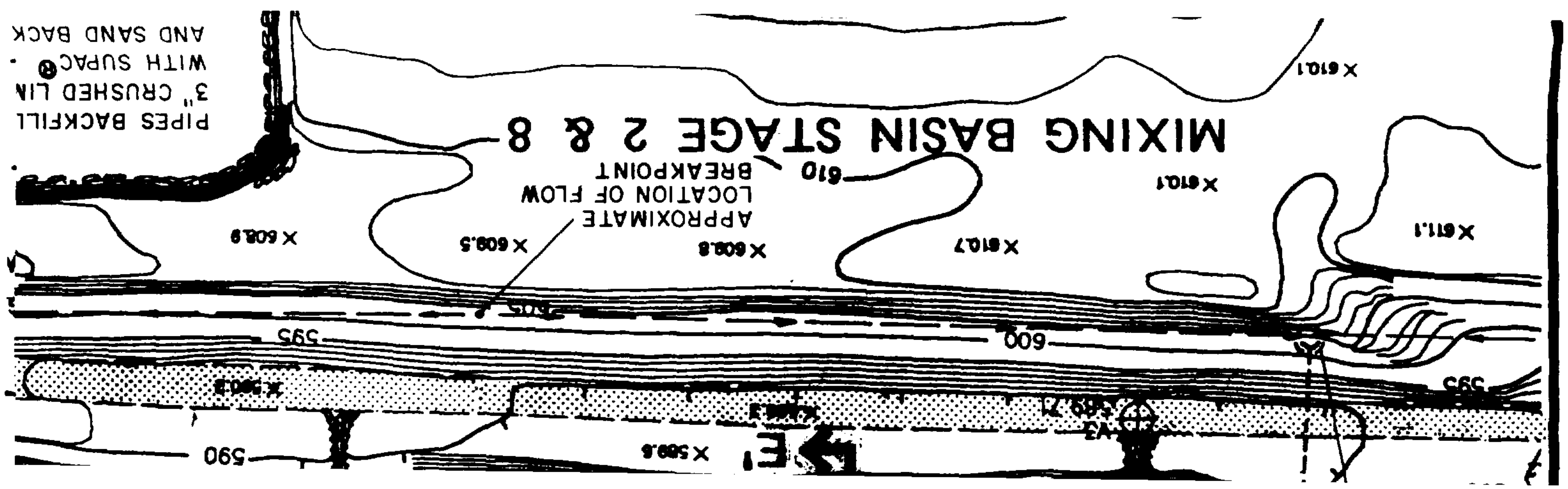

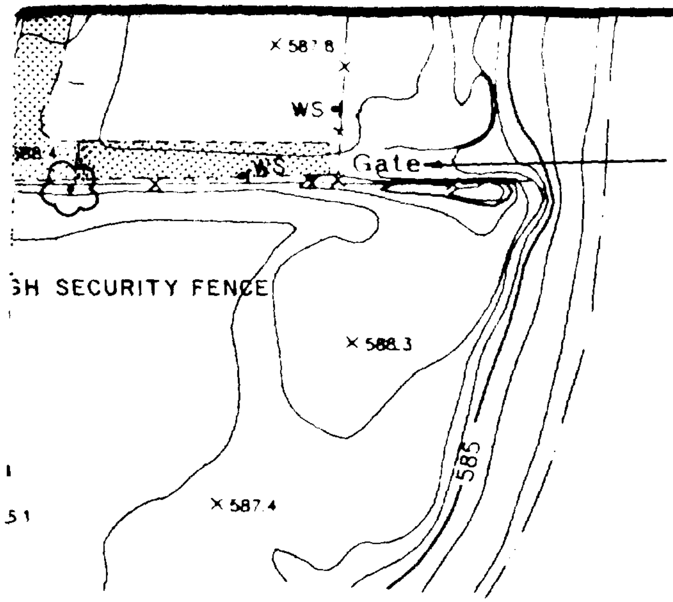

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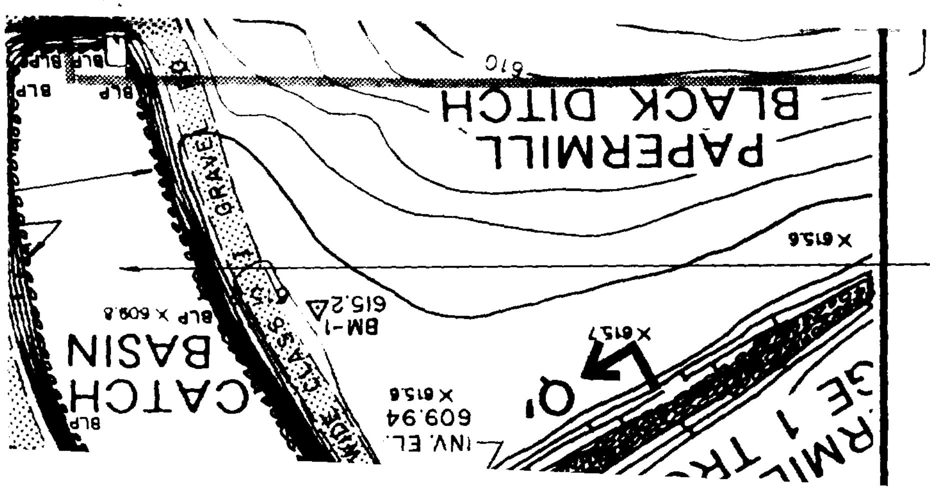

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ONSTRUCTION WORK

SECTIONS

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CONESTOGA-ROVERS & ASSOCIATES

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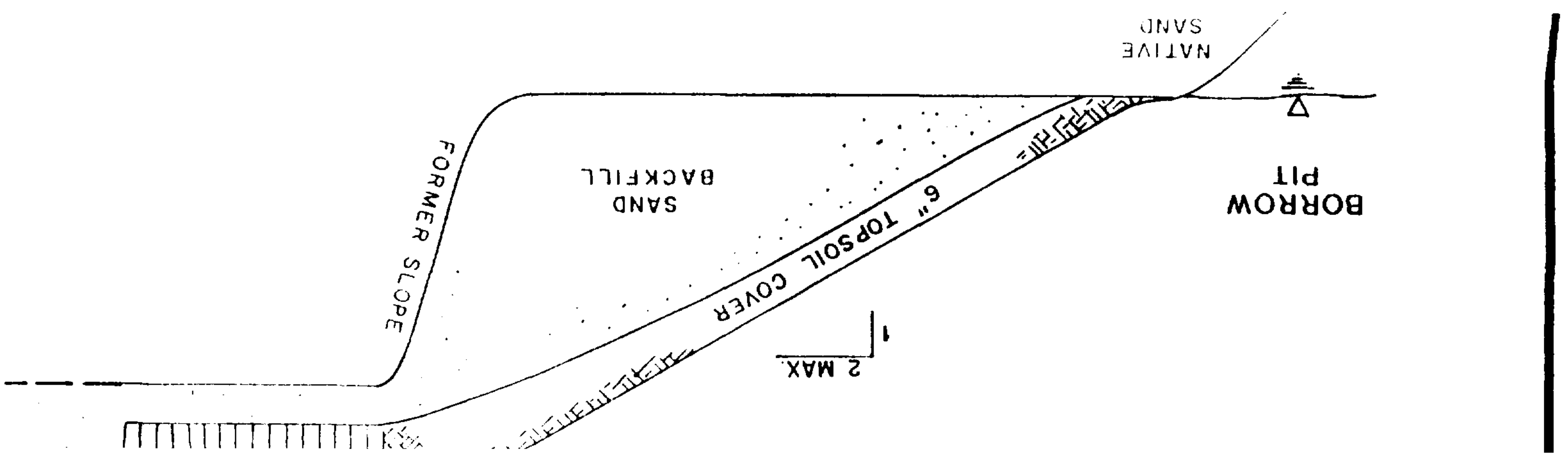

MANVILLE DISPOSAL AREA
GAN, ILLINOIS

ONSTRUCTION WORK

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SECTION K-K'

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SPREA
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HORIZONTAL SCALE : 1" = 25'
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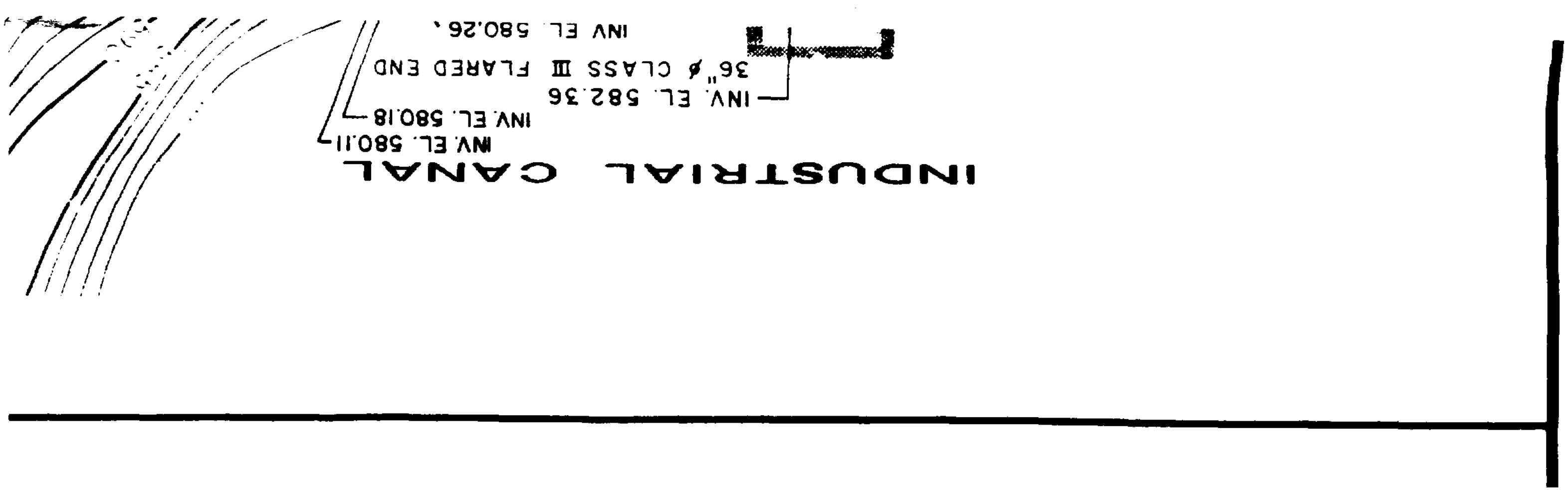

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ONSTRUCTION WORK

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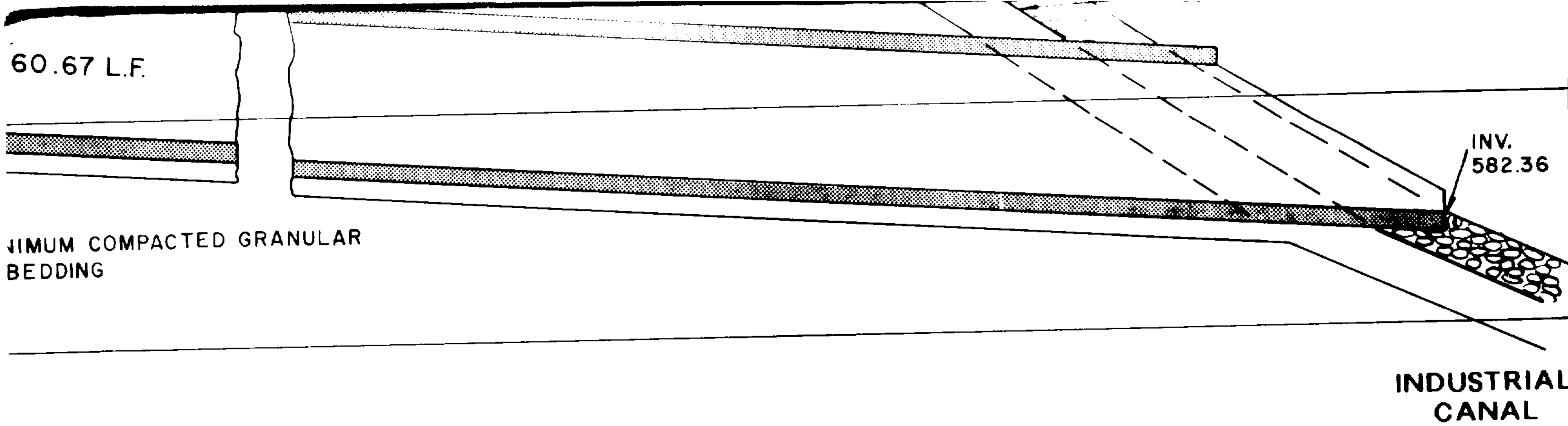

ANVILLE DISPOSAL AREA
GAN, ILLINOIS

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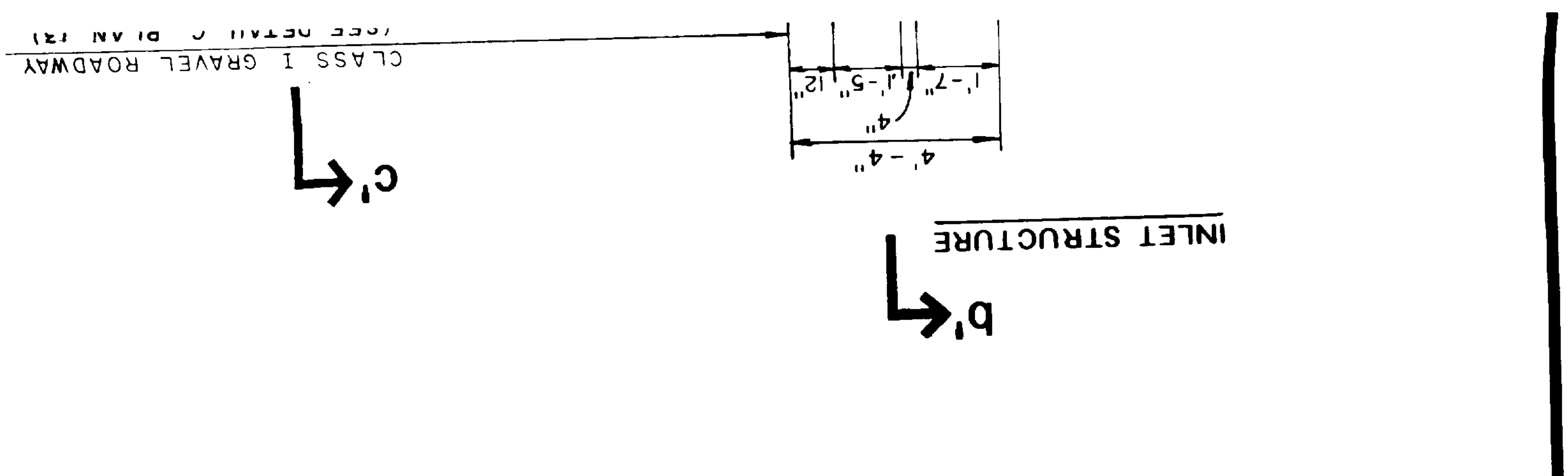

DETAIL G

ELL EXTENSION FOR MONITORING WELLS

MW-X AND MW-Y

NOT TO SCALE

ANVILLE DISPOSAL AREA
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DETAILS

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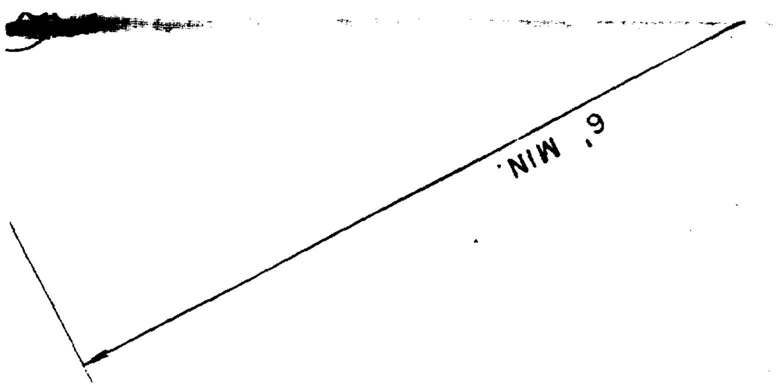
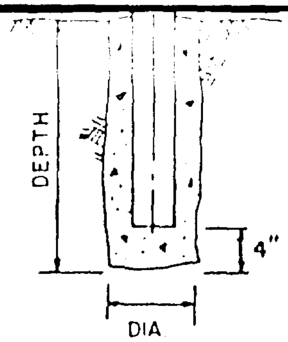
Designed by: S.J.				
Checked by: S.J./R.G.S.	Field book	Project Nº 2980	Drawing Nº PLAN 13	



8	36
10	40
10	40
12	42



DESCRIPTION	OD	LENGTH
LINE	2 ½"	9'-0"
END, CORNER, STRAINING AND DOUBLE OPENING GATES. 16' WIDE & 24' WIDE	4"	10'-6"

FENCE DETAILS

NOT TO SCALE

ANVILLE DISPOSAL AREA
GAN, ILLINOIS

ONSTRUCTION WORK

DETAILS

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: NULY	Scale: AS NOTED	Date: OCTOBER, 1991	File Nº	Rev Nº
Designed by: S.J.	Field Book	Project Nº 2980	Drawing Nº PLAN 14	
Checked by: S.J./R.G.S.				

[redacted]

2. DROP OFF EQUIPMENT, TOOLS, ETC.

1. RINSE GROSS CONTAMINATION FROM EQUIP... OUTER PROTECTIVE CLOTHING, ETC. DECON... VEHICLE IS LEAVING SITE.

SITE EGRESS AND DECONTAMINATION PROC...

EQUIPMENT DECONTAMINATION PAD

DECONTAMINATION AREA PLAN

NOT TO SCALE